MANUAL OF LEPROSY

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Preface

LEPROSY is not an easy disease to understand and it is *difficult for the busy physician to gather* the necessary minimum of knowledge required to make a definite diagnosis and carry out treatment He has no time to study a full sized leprosy textbook, and the information he finds in a book on General Medicine is often out of date and lacking in practical details

In the United Kingdom leprosy is uncommon, but *physicians* practising in tropical or subtropical lands are likely to meet with cases more or less frequently

Then there are those—doctors nurses and lay workers—who are specially engaged in anti leprosy work and who require a small handy book which will either give them the needed information or refer them to another source

It is with all these in mind that this small book has been *written*

Part I gives a short explanation of the nature of leprosy and attempts to elucidate its widely variant and puzzling phenomena thus laying a foundation for understanding the principles of diagnosis, treatment and control

Part II seeks to deal with diagnosis, *treatment* and prognosis in as practical a way as possible All controversial *points are omitted* and the simplest and *most approved* methods are given

Part III describes the general principles of a campaign against leprosy and particulars of the measures to be taken Details are given of how to erect and manage a leprosarium

carry out a survey establish out patient clinics and village isolation centres and conduct welfare and educational work

Special reference is made to India Africa and the West Indies where the author has gathered most of his experience

Coloured and black and white photographs illustrate the clinical and histological appearances of the various types and sub types of leprosy

To help those who wish to make a wider study a bibliography of books and journals is added at the end classified *under the numbers of the chapters and again many of these* give fuller lists of references

ERNEST MUIR

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ACKNOWLEDGMENTS

I wish to acknowledge my great indebtedness to Mr T C Dodds of the Pathology Department Edinburgh University for his kindness and skill in preparing five photomicrographs of skin sections four of these being in colour and one in black and white and to Professor C H Percival Professor A Murray Drennan and Mr T C Dodds for permission to use Fig 201 of their Atlas of Histopathology which appears as Fig 1 in this book

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PART I

THE NATURE OF LEPROSY

MANUAL OF LEPROSY

CHAPTER ONE

History *and* Peculiarities

LEPROSY has many peculiarities which distinguish it from all other diseases It appears to be one of the oldest disorders described in history but records should be accepted with reserve as the disease referred to often bears no resemblance to what is now known as leprosy

The highly contagious condition described in the Jewish Law (Lev xiii xiv) has obviously nothing to do with leprosy and the disease of Naaman the Leper (2 Kings v) is more likely to have been scabies which is still cured by bathing in the sulphurous springs of the Jordan Valley (Lie 1938)

On the other hand the account given of King Uzziah (2 Chron xxvi 19) is a clear picture of what happens in an early case of the lepromatous type emotional flushing of the facial capillaries makes the lesions suddenly stand out in relief (p 32)

Leprosy seems to have originated either in the Far East or in North Africa to have reached Europe about 500 B C along with the Persian armies to have been spread later by the Roman legions to North and West Europe and to have first entered the Americas with the early Spanish and Portuguese immigrants

Among the peculiarities of leprosy are its low toxicity its long latent period its insidious onset and long duration

Our inability to culture the lepra bacillus outside the human body has hampered study of the disease and rendered treatment and control more difficult

One of the unique things about leprosy, in which it differs from all other bacillary diseases, is its attraction towards the peripheral nerves

Perhaps the most important but least understood phenomenon is the delayed tissue reaction to lepra bacilli which is effective in limiting infection in some cases but not in others, thus dividing leprosy into two contrasting types, tuberculoid and lepromatous

The *only other human disease* which bears any resemblance to leprosy—and that not a close one—is tuberculosis They resemble each other in the morphology of their bacilli and in certain lesions of the skin, but leprosy shows even more striking contrasts in attacking the peripheral nerves and leaving the lungs, intestines and central nervous system unaffected

Leprosy has one great advantage over tuberculosis in that its chief clinical lesions are on the surface of the body, and therefore easily inspected and tested Apart from bacteriological examination, the chief instrument required for early diagnosis is not an X ray set *but only a feather or a piece of* cotton wool

Yet the study of tuberculosis has been of considerable value in helping the study of leprosy and promises to be of even more use in future

The superstitious dread which throughout the world and in all ages has surrounded leprosy and has won it in India the epithet The Great Disease, has added much to the sufferings of its victims and often made it more difficult to gain their co operation

Leprosy is a social as well as a physical disease and this must be kept in mind in all plans for treatment and control

CHAPTER TWO

Bacteriology

MYCOBACTERIUM LEPRÆ more commonly known as the lepra bacillus is accepted as the cause of leprosy although academically at least full proof is still wanting seeing that it has not yet been cultured *in vitro* or inoculated successfully in animals

Leprosy was looked on as an infectious disease in the fourteenth and fifteenth centuries and stringent laws to prevent contact with healthy people were enforced in England and other European countries But the interest taken in heredity towards the beginning of the nineteenth century and the fact that leprosy often lingers in a family through several generations favoured the belief that the cause was hereditary This theory received the support of the Royal College of Physicians London in 1862 and the consequent relaxation of the rules for isolating patients led in some instances to increased spread of the disease (Lowe 1939)

The discovery of the bacillus by Hansen early in the eighteen seventies confirmed the previous opinion that leprosy is spread by infection Although Koch s postulates have not been satisfied it is established almost universally that Hansen s bacillus is the cause

Like the organisms causing the various forms of tuberculosis Johne s disease and rat leprosy Hansen s bacillus is classified as a mycobacterium It is gram positive and acid fast Stained by Ziehl Neelsen s method it appears as a rod up to 8 μ in length or it may be beaded or diphtheroid with bipolar staining (Fig 3)

Some rods are more acid fast than others and there is evidence that some are non acid fast though the significance of this is not known

M lepræ like other acid fast bacilli contains in its structure a large proportion of waxy (lipoid) material in addition to various proteins In the lepromatous type of leprosy in smears or sections stained by Ziehl Neelsen s method bacilli are seen either singly or in rounded masses embedded in

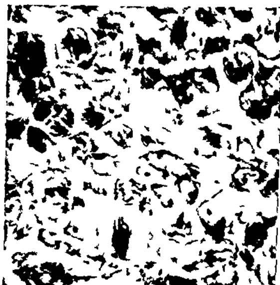


Fig 1

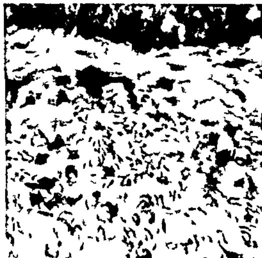
Lepra bacilli stained red some lying free the majority within the large macrophages (histiocytes) called lepra cells of Virchow The colour micr photograph is reproduced from Fig 201 in Atlas of Histopathology C H Percival A Murray Drennan and T C Dodds with the kind permission of the authors

lipoid material These masses are known as globi from their globular shape (Figs 1 2) When the preparation is coloured with tissue stains like hæmatoxylin and eosin these globi appear in Virchow s lepra cells which are sometimes known as foamy cells from their vacuolated appearance (p 39) (Fig 16)

Culture and Inoculation

Claims have been made from time to time that *M. lepræ* has been cultured *in vitro* or successfully inoculated in animals but none of these claims have been satisfactorily confirmed

There are in nature many bacteria and other organisms which are strongly or weakly acid fast and others which



F

Sect f nd l wit c b ned t s an l ba ll s ta n ng N t round red t ed gl l s n f wl l ppe d l p ll gl t a ll scattered thr gh th ti ues n n-c ll l r bep d m l l y (6)

when grown on certain media especially those containing egg tend to become acid fast These organisms are found in the nose and under the prepuce (smegma bacilli) and even in the tissues of the body also in timothy grass dung and butter and in the soil Contamination of cultures with one or other of these germs has been one of the main causes for mistaken claims of successful culture of *M. lepræ*

We have a reliable test as to the genuineness of such a culture for *M. lepræ* perhaps alone of all known acid fast

organisms gives consistently negative results when used as the antigen in performing the lepromin test (p 23) in a lepromatous case

M lepræ can at times be very resistant to destruction in animal tissues and bacilli killed by boiling and injected into



Fig 3

Smear from biopsy of lepromatous skin showing globi and polymorphous staining of single bacilli

rats have been found still acid fast after eighteen months Claims have been made that dead lepra bacilli can be distinguished from living by their staining reaction, this is doubtful and difficult to prove or disprove

For preparation staining and examination of biopsy smears see pp 84 to 87

CHAPTER THREE

Mode *of* Infection

OUR inability to grow the bacillus outside the body is a handicap in tracing the paths by which infection is transmitted

DISCHARGE OF BACILLI

We know however that in the severer type bacilli are given off in large numbers from the nose mouth upper respiratory passages and skin and this is increased when there is ulceration or an acute exacerbation We cannot distinguish between living and dead bacilli but there can be little doubt that many of those shed from the body are alive

As in tuberculosis droplet transmission from the nose and mouth is probably one of the most common methods The sputum is often heavily infected especially when during exacerbations nodules of the trachea and larger bronchi soften and burst discharging pus laden with bacilli

PATHS OF ENTRY

The paths by which bacilli enter the body are more difficult to trace Experimental inoculation in volunteers except for one or two doubtful cases has given negative results

There are however many instances of the disease developing at sites of accidental inoculation such as excoriations of the skin scratching of insect bites scratching the nose by worm infected children puncture of the skin while operating on or dressing a patient

It may even be possible for bacilli to enter through unabraded skin as in the case of an Indian barber whose only lesion was a tuberculoid lepride corresponding exactly

with the area on his forearm where he was accustomed to strop his razor after shaving a lepromatous case (p 49)

We have no proof whether or not infection takes place through the gastro intestinal tract, but the fact that tubercle bacilli may enter the tonsils and other lymphoid tissue and thence find passage by way of lymph nodes into the body, is presumptive evidence that lepra bacilli may do the same

INSECT TRANSMISSION

This is a possibility of which we have but little certain proof Lepra bacilli have been found in the gut of flies lice ticks bugs fleas mosquitoes and cockroaches Castro claims to have obtained a positive microlepromin test by feeding mosquitoes on leproma and later feeding them on a healthy portion of the skin of a leprous patient who was known to give a strong reaction to the lepromin test (p 23) Otherwise we have no direct proof of insects inoculating infection

Moiser (1946) has put forward the theory that the cockroach transmits leprosy—it bites a leprous patient and absorbs bacilli into its gut, where they multiply and undergo certain changes, and are again transferred to man either by the insect s bite or by infection from its fæces No confirmation of this theory has yet appeared

There is undoubtedly the possibility of insects carrying bacilli in their fæces or on their feet especially from uncovered lepromatous ulcers and depositing them on the intact or even the abraded skin of a healthy person and an important role in transmission is probably their irritating bite followed by reflex scratching of the skin thereby helping the entry of the bacilli already deposited on the skin or under the nails (Asami 1934)

CONTACT HISTORY

Many patients give a negative history of contact with leprosy and this fact has been advanced in favour of insect transmission There are however definite reasons for an absence of contact history The length of the incubation—from six months to twenty years with an average of three and

a half years—makes it difficult for a patient to remember especially if he was very young at the time of contact

It is not uncommon for an infectious patient who appears quite normal and who may be quite unaware that he has leprosy to continue to shed bacilli from his skin and nose for two or three years before the more obvious signs appear and the disease is recognised During that period he must have innumerable unsuspecting contacts (pp 79 10)

Indirect transmission occurs at times through wearing a patient s clothes using his furniture and other appliances or living in a house vacated by a patient (p 178)

It may be taken as a rule that positive histories of contact increase in direct ratio to the thoroughness with which cases are followed up to their homes and their past history investigated

CONTACT RATES

Contact rates are (*a*) the number of lepers with familial (household) contact per 100 cases of leprosy (*b*) the number of lepers with extrafamilial contact per 100 cases of leprosy (*c*) the number of lepers with contact unknown per 100 cases of leprosy

DANGER IN CHILDREN

Children are particularly liable to infection This may be due to naturally low resistance thinner and more easily penetrated skin or inability of a child to realise danger and protect itself from infection (p 179) (see Figs 66 69 70)

So important is child infection that it might be stated if all children were kept free from contact with infection for the first ten years of life leprosy would almost or entirely die out of an endemic country within two generations

For Age Groups and Childhood Rates see p 16

WATER AND SOIL INFECTION

The author has often been consulted as to the danger of infection through patients contaminating water of a river or stream used by healthy people This would of course depend upon the size of the stream and the proximity of the respective watering places of patients and healthy people It should be

kept in mind that the germs of water borne diseases like enteric and cholera multiply rapidly in water and readily infect on being swallowed Whereas *M lepræ* does not multiply outside the human body and it is very doubtful if any harm would result even supposing by a very remote chance a few lepra bacilli were swallowed At the same time separate water supply should as far as possible, be arranged Likewise the danger from walking on ground or soil trodden on by patients is as a rule very remote at least to those wearing shoes

Risk of Infection

Speaking generally the risk and the gravity of infection are in direct relation to four factors —

(*a*) The closeness of contact (bed, room, house neighbour employment casual intercourse)
(*b*) Frequency and length of contact
(*c*) The infectiousness of the infector
(*d*) The susceptibility of infectee (see Resistance p 21)

Incubation Period

This term is used in a general sense as the period between infection and the appearance of the first noticed lesions Neither of these can be more than approximate since the time of a possible effective infection may spread over years in a family contact and the recognition of first signs may be delayed over a still longer period by the slow and insidious onset of the disease

First signs of leprosy have been seen in a six months old child, and have been found in an adult twenty years after the apparently last chance of infection

The average is, however considered to be about three and a half years

Chapter Four

Prevalence *and* Rates

In this chapter we discuss briefly (*a*) the total prevalence of leprosy (*b*) the more important rates of type age sex race class and (*c*) the effects of climate Some of these will be dealt with again in Part III

Total Incidence

It is very difficult to make anything approaching a correct estimate of the total extent of leprosy in the world The figures below amounting to 3 540 000 are only approximate as large areas in Africa South America India and China have never yet been surveyed The probable number with early and mild cases included would be somewhere in the region of 5 000 000 (see Table I)

Type Rate

The number of lepromatous (severe) cases per 100 cases of leprosy—known as the type rate varies widely from one country to another In many parts of India it was found to be round about 1 in 5

According to the hypothesis explained on p 21 the great majority of people are strongly resistant to infection and require repeated and close contact to induce the disease which is then generally of the mild type The minority remain anergic and may acquire leprosy of the severe type even with casual contact

Thus in endemic countries the closer more frequent and more prolonged the contacts with open cases—overcrowding dirt and promiscuousness the higher will be the total prevalence and especially the prevalence of mild and abortive cases

TABLE I

APPROXIMATE PREVALENCE OF LEPROSY

Continent	Country	Number	Totals
Asia	India	1,200 000	
	China	1 000 000	
	Japan	102 000	
	Netherlands East Indies	100 000	
	Others	121 000	2 523 000
Africa	Nigeria	400 000	
	Other British	101 000	
	French West and Equatorial	102 000	
	Other French	10 000	
	Belgian Congo	200 000	
	Portuguese	26 000	
	Egypt and A E Sudan	26 000	
	Ethiopia and Eritrea	8 000	
	Others	2 000	875 000
Europe	Russia	10 000	
	Spain and Portugal	7 000	
	Others	4 000	21 000
America	Brazil	50 000	
	Columbia	30 000	
	Argentina	8 000	
	Venezuela	5 000	
	Mexico	4 000	
	United States	2 000	
	West Indies	7 000	
	Others	5 000	111 000
South Pacific		10 000	10 000
			3 540 000

and therefore the lower the type rate (proportion of severe compared with total cases)

Let us suppose by way of illustration that say one out of every ten people is particularly susceptible to leprosy and liable to contract the disease after a comparatively casual exposure to infection also since he has little resistance he is likely if once infected to develop the severe lepromatous type The other nine tenths being resistant cannot acquire the disease at all except after multiple intensive exposures

Let us next suppose two countries—A and B—with equal populations In A the hygiene is moderately low and though people are exposed to leprosy contact the exposure is moderate and produces the disease chiefly in the susceptible ninth of the population who develop the lepromatous type (75) The slight exposure can cause disease (mild type) in only very few (25) of the resistant nine tenths of the hundred cases in all

In B on the other hand the hygiene is extremely low and a rather higher number (100) of the susceptible ninth develop leprosy (severe type) than in A but the exposure of the whole population being much more intense is sufficient to cause leprosy in 300 of the resistant nine tenths but of mild type

The position is clarified by reference to the table —

	A (Higher Standard)	B (Lower Standard)
Severe cases	75 (75 per cent)	100 (25 per cent)
Mild	25 (25)	300 (75)
Total cases	100	400

Notice that the number of severe cases is more in B than in A (100 to 75) but the percentage of severe cases as compared with the total is greater in A than in B (75 to 25 per cent) Thus the type rate is higher in the more hygienic of the two countries and a rising type rate is one of the signs that leprosy is diminishing in a community (see also p 162)

AGE RATE

As in tuberculosis infection is most common in the first few years of life In India out of 3 380 in leprosy institutions more than half showed signs of disease before the age of 21 while in the large Calcutta leprosy clinic the figures were practically the same

Age Groups

The following age grouping is used in recording age rates 0 4, 5 9, 10 14, 15 19, 20 29, 30 39, 40 49, 50 59 and 60 or more A child is any person falling within the first three age groups The Childhood Rate is the number of child lepers per 100 cases of leprosy

The same circumstances which cause a low lepromatous rate (see above) and therefore increase the chance of infection, provoke a high child rate

The two main signs that leprosy is diminishing in an area are a high lepromatous (type) rate and a low child rate This holds good down to a certain point where only lepromatous cases remain and then the survivors of this group as they pass on to the later stages may lose lepromatous signs and retain only their secondary crippling lesions Such was found to be the case in Norway as leprosy gradually died out of the country

Sex Rate

This is the number of male lepers per 100 cases of leprosy Most statistics show that leprosy is more common in men than in women somewhere in the region of 2 to 1 This may be due to the greater stress borne by men, and the greater opportunity that they have of infectious contact while away from home

On the other hand, there is the possibility of a physiological element in the endocrine or cytological make up of women as compared to men (Lowe and Chatterji 1939)

Occasionally the incidence is higher in women as in the Loyalty Islands where this was attributed to the greater sexual promiscuity of females, and in Basutoland, where the women are fat and lazy the men doing the hard work

Race Incidence

There seems no doubt that the severity of leprosy varies in different races For instance in Burma the disease is of a much worse form in Burmans than in Indians living in Burma (Lowe 1938) In Malaya it is of a more severe type among the Chinese than among the Indians

A considerable difference was found in the types in two provinces of Eastern Nigeria only 200 miles apart, though

in both there was a very high incidence How much of this is due to physiological differences and how much to social and dietetic customs is difficult to say

Average severity of type (that is a high lepromatous rate) and low child rate have been shown as the two signs that leprosy is dying out of an area (see Type and Age Rate above) so that it would be necessary in comparing race incidences to consider these two rates in each community

Whatever racial physiological differences there may be as regards susceptibility to leprosy hygiene and standard of living are much more important factors in the control of the disease in any race or community (p 150)

CLASS INCIDENCE

Generally speaking leprosy is much more common in the poorer and less hygienic classes of a community In India however social status is based more upon birth into a caste than upon wealth and cannot therefore be taken as an indication of the standard of living and hygiene Thus leprosy is found among the highest and the lowest and the wealthiest and the poorest (Muir 1932)

As long as leprosy is endemic in a country no one can be considered free from danger of infection whatever his class During the pre clinical infectious stage the patient is always liable to spread infection to his unsuspecting contacts

CLIMATE

Much has been written on this subject and there seems no doubt that a hot moist or cold moist climate promotes leprosy among people with low standards The hot moist climate in insect infested swamps encourages self inoculation through scratching of irritating bites while the cold moist climate en courages crowding together in inadequate room and bed space – both ideal conditions for the spread of infection in a family (Lowe and Chatterji 1939 Mills 1936 Shionuma 1938)

Some have stated that seaside residence is bad for leprosy but more evidence is required

A temperate fairly dry climate is the best in leprosy as in tuberculosis and diurnal and seasonal temperature variation if not excessive are an advantage

CHAPTER FIVE

Resistance *and* Tissue Reaction

TISSUE reaction must be distinguished from what is generally known as 'lepra reaction, which is discussed in Chapter Eight One of the most striking and puzzling features of leprosy is its low toxicity when compared with other diseases—the fact that in some cases the skin may contain millions of lepra bacilli to the square inch, and yet for a considerable period to begin with the patient may show little or no toxic symptoms, and the presence of bacilli may cause only such slight clinical signs that he is not even aware of the existence of serious disease

NATURE OF TISSUE REACTION

The signs and symptoms of leprosy—macules leprides *infiltrations nodules swelling of nerves—are caused by local* reaction of tissue cells to bacilli which have invaded their neighbourhood This tissue cell reaction may be taken as *an attempt—varying very much in its degree of success—to* destroy the invading bacilli

The theory is propounded that this reaction is of an allergic nature All patients are anergic to *M lepræ* to begin with In some the bacilli on entering the tissues provoke after a short delay a local allergic reaction which is capable of destroying or limiting the spread of infection In others delay is longer and the allergic activation when it comes is ineffective and incapable of destroying or limiting infection (Rotberg 1939 Davey 1946)

It is not known whether ytes take part, but the reaction is chiefly centred in the skin and the lial sy

The following important points should be noted —

(*a*) Reaction does not take place immediately a varying time lag intervenes between contact of bacilli with cells and activation of cells

(*b*) Reaction when it does take place varies widely in intensity

(*c*) Activation is confined to the site of contact between cells and bacilli but local activation seems to bring with it a systemic change by which future activation takes place more readily in new or extending lesions

(*d*) Activation does not remain at one intensity but fluctuates Thus there is an ebb and flow in the colour thickness and conspicuousness of the lesions and also in the number of bacilli found in biopsy smears Nodules and macules may appear and disappear in a few days time flare ups may cover a few weeks or months or the fluctuation may be seasonal reaching its height generally in the hottest or most trying time of the year (see p 17)

(*e*) Other things being equal reaction is at first in direct ratio to the number of bacilli but bacilli in great excess seem to quash reaction

We have no exact knowledge of what takes place when an activated cell comes in contact with one or more lepra bacilli but the following hypothetical description fits the known facts

Reaction shows itself in cellular multiplication and infiltration bacilli are ingested and to a varying degree phagocytosed by the cell It is not clearly known whether the small round lymphoid cells which form the basis of the infiltration in all types originate in the local tissues or are partly derived from the blood stream But *it is probable that* the characteristic cell the lepra cell in the lepromatous and the epithelioid and giant cell in the tuberculoid – are chiefly if not entirely of local monocyte (reticulo-endothelial) origin

Degree of Resistance

The difference between these two types—lepromatous and tuberculoid—depends on the degree of resistance of the patient and the amount and timeliness of cellular activation

When these are low, the cell ingests the bacillus but is unable to destroy it Instead the bacillus multiplies in the cytoplasm and the lepra cell (pp 6 40) is formed

When they are high, the cell destroys the bacillus and takes on an epithelioid or multinuclear (p 59) appearance

It is less clear what takes place in cases where neither of these characteristic cells appear but apparently there is some mild reactionary process, and the bacilli are unable to multiply to the great numbers that they do in the lepromatous type

The localised nature of cellular activation is shown in some of the varieties of leprides (p 50) The bacilli infiltrate surreptitiously through the surrounding clinically normal skin and are pursued by the line of advancing activation indicated by the spreading inflammatory margin of the lepride

The statement that up to a point reaction is in proportion to the number of bacilli is confirmed by the tuberculoid variety of lepra reaction (p 62) in which delayed activation allows the bacilli to multiply to a greater (but yet limited) extent in the skin and nerves When at last the cells are activated they find many bacilli accumulated and like fire with abundant fuel their inflammatory outburst is so intense that it not infrequently causes complete elimination of bacilli (Fig 42)

The lepromatous type where bacilli multiply to huge numbers without any proportionately great reaction suggests the quashing of activation by excessive numbers of bacilli Lepra reaction with its bearing on this subject is discussed in Chapter Eight

The lepromin test (p 23) throws considerable light on the question of resistance and tissue reaction

Nature of Resistance

There is no evidence that *M lepræ* can incite effective general immunity No specific serological test has been found

practicable and the lepromin test is specific only when in a case of leprosy its result is negative

Resistance as found in leprosy may roughly be divided into four kinds —

(a) *Natural Resistance* —This term is given to the ability of the body to produce a timely and efficient reaction to



Fig 4

D ff se lep m i [illegible] f ltr i n of th th gh Three form r tubercul [illegible] les ons t nd out a un ffected by th [illegible]

bacilli when they enter the tissues This reaction is sufficient either to suppress the infection immediately and entirely or at least to limit and circumscribe its growth The power thus to react is present in the great majority of people but is absent in a minority As far as we know it is not directly dependent on the

general health seeing that patients in poor healt often show marked resistance and limitation of thei lesions, while others in spite of a strong constitution and excellent health go on rapidly to the more severe type (see p 113)

(b) *General Health*—As in tuberculosis this factor is o undoubtedly great importance, though not of the same order as natural resistance Other things being equal the strong healthy, vigorous man is more likely to resist or to recover than the weak ill nourished one (see p 115)

(c) *General Acquired Resistance*—This is shown by the tendency in lepromatous cases who have reached the fourth stage (p 34) to eliminate infection and in some cases to recover, apart from any special treatment

(d) *Local Acquired Resistance*—The flat centre of an active spreading lepride (p 52) illustrates this Some change has taken place in the centre which prevents the infection turning back on its trail Also such an area will often remain unaffected when a tuberculoid case degenerates into a lepromatous and the sur rounding skin is infiltrated (Fig 4)

It remains to be seen whether treatment with sulphones can bring about the stimulation of natural resistance when it has reduced the number of bacilli in the body (Chapter Nineteen)

General Health

The general health of the patient has been mentioned as of great importance as it is in tuberculosis, and secondary only to the natural resistance In the tropics patients admitted to leprosaria are generally found to be suffering from compli cating conditions—malaria helminthic infestation sepsis of teeth etc venereal disease and above all malnutrition Mental depression also leads to physical depression In women pregnancy (Juillot and Curci 1946) is another serious complication All these lower the patient's resistance and predispose to leprosy, and their removal often results in an amelioration of the leprous condition

LEPROMIN TEST

Use

Many attempts have been made to find a serological or a skin test to assist in the diagnosis of leprosy None has so far proved of general practical use and it is easier and surer to diagnose by clinical or bacteriological methods But the histamine and pilocarpine skin tests are of value in certain very early cases (p 89)

The lepromin test is not used for diagnosis Its value is in (*a*) estimating the resistance of the already diagnosed patient (*b*) confirming the type (*c*) making the prognosis and (*d*) giving guidance as to treatment

It may also be used in testing supposed cultures of lepra bacilli as *M lepræ* used as antigen in the test invariably gives a negative reading in lepromatous cases while other acid fast organisms when used as antigen generally give a positive reaction

Technique

A suspension of antigen containing lepra bacilli is injected intradermally The result is read after twenty four to forty eight hours or after four to six weeks or both

Antigen —As lepra bacilli cannot be cultured *in vitro* it is necessary to prepare the antigen from leproma obtained from patients There are two methods of doing this the original way used by Mitsuda the originator of the test and a much more accurate one which though requiring more time permits of exact standardisation

(*a*) Excise a number of lepromatous nodules generally from patients ears Sterilise by boiling in water for forty minutes remove all epithelium mince up fine with knife or scissors desiccate over sulphuric acid or calcium chloride in a vacuum jar Grind up fine in a mortar adding sterile saline in small quantities pipette off supernatent fluid Repeat this several times till most of the material has been suspended The suspension can be roughly standardised by counting the number of bacilli on a hæmocytometer slide Usually 0 2 c c is injected intradermally

(*b*) Dharmendra (Dharmendra and Lowe, 1943) has described a much more accurate method of obtaining bacilli free from tissue and lipoids He grinds up nodules in chloroform, obtaining a suspension, which when pipetted off contains the bacilli and is free from tissue The chloroform is evaporated and the residue extracted with ether to remove lipoids The residue is dried weighed and suspended in saline to the standard strength of 1 mg of powder in 10 c c of saline The dose is 0 1 c c

It is of great importance that there should be a standard antigen and a standard method of performing and reading the test Dharmendra s method is the one of preference but those who have not the facilities for preparing the antigen in this way must be content with the less accurate method

Performing the Test—The antigen should be kept in sealed glass ampoules sterilised and ready for use Inject the antigen into the skin, raising a small wheal Two injections should be made one in the centre of a lesion and the other in apparently healthy skin , the reaction is sometimes stronger in the former than in the latter

Reading—Using Dharmendra s antigen, if the test is positive there is an angry flush, 6 to 12 mm in size, at the site of injection in twenty four to forty eight hours and a nodule forms gradually from the third to sixth week (average reading four weeks) which is 4 to 12 mm in diameter and if strongly positive liquefies and bursts at the centre Readings should be registered as − +, + +, or + + + (see p 103)

With the first described antigen the immediate reading is less strong but the delayed reading is equally or more strong

The lepromatous type gives a uniformly negative reading The tuberculoid gives a positive reading varying in intensity as between cases and often varying in repeated tests from time to time in each case

In uncharacteristic cases the reading varies between negative and slightly positive

Speaking generally, the higher the reading the greater the natural resistance and the better the chance of recovery If the reading is weak especially if this occurs during a tuberculoid reaction, the test should be repeated as there is sometimes temporary suppression

A subject of great interest is whether the positivity of the lepromin test can be enhanced by the injection of *M lepræ* or other acid fast organisms Miranda (1946) states that 123 children negative to both the lepromin and the Mantoux tests were vaccinated with B C G In a month the Mantoux reaction was positive in all but one and the lepromin was positive in 87 (70 7 per cent) weakly positive in 26 (21 1 per cent) negative in 10 (8 1 per cent) only

Another matter of interest and importance is to what extent the lepromin test in lepromatous cases will alter from negative to positive under sulphone treatment (p 108)

CHAPTER SIX

Classification *of* Leprosy

LEPROSY, though it does in many cases attack the internal viscera is on the whole confined to the outer part of the body and its clinical signs are chiefly in the skin mucous membranes and superficial nerves, where they can easily be examined

It is partly on account of their easy accessibility that the protean signs of leprosy appearing in different patients are so puzzling to those who have not had occasion to study many cases

In the past, authorities working in different countries have made statements difficult to reconcile with each other, except on the supposition that the same terms were used with different meanings

It has also been realised recently that there are considerable variations from place to place as regards the severity and the relative numbers of each type

For these and other reasons it is important to have a classification of cases and lesions which is scientific flexible accurate easily understood and applied, and universally accepted

There are various criteria on which classification of any disease can be based according to its nature—etiology structure clinical signs topography bacteriological findings resistance to infection etc

Tuberculosis, for instance, affecting in each case more or less exclusively one or other organ—lung kidney meninges skin bone etc —must primarily be divided on a topographical basis

Leprosy was formerly divided into *Nodular* (or *Tubercular*) and *Maculo anæsthetic* to which later was added *Mixed* So long as it was considered an incurable disease and the earlier

lesions found in tropical and sub tropical countries were not known or considered this purely clinical and superficial classification was adequate

At a conference held in Manila in 1931 the classification was changed to a topographical one the division being between *Cutaneous* and *Neural* (Report 1931)

At the International Congress in Cairo in 1938 the classification was modified to *Lepromatous* and *Neural* which is partly structural and partly topographical rather an unsatisfactory compromise

At the Pan American Congress in Rio de Janeiro in 1946 this was again modified to *Lepromatous* and *Tuberculoid* both being consistently structural and based upon histological findings Also an intermediate type was inserted between these two polar or strongly contrasting types called for want of a better name *Uncharacteristic* to describe cases without either of the two typical structures

This structural basis was adopted because it was realised that the basic difference between the two main types is not dependent on the topographical position—skin or nerve—in which the disease is situated or on such local signs as nodules and macules or yet on sensory changes such as anæsthesia All these occur in varying degrees in both polar types

The actual difference is in the degree of resistance of the tissues to the bacillus Low resistance produces a definite histological picture known as leproma (p 40) which appears in all tissues—skin mucosa nerves internal organs hence the lepromatous type (lepromatous being the adjective from leproma) High resistance gives a distinctly different picture known as tuberculoid (p 49) and this is found both in skin and nerves

The first of these two histological pictures is the result of anergy or absence of effective tissue reaction the second is the result of timely and more or less effective tissue reaction But one or other of these pictures is not always present in the early stages There is as it were a pre lepromatous incubation period and a pre tuberculoid incubation period in which the reaction to the bacilli is slight or absent The affected tissue during this period often shows a structure which does not

clearly indicate the type which will ultimately evolve and one which may even be difficult to distinguish from that of other chronic inflammatory non leprous conditions Hence the term, *Uncharacteristic* which is applied (Chapter Ten)

This type also includes residual cases in which during resolution but before complete healing, the characteristic histological picture has been lost There are also cases of what might be called arrested development with lesions which increase in size but continue to hold their early uncharacteristic chronic inflammatory structure Lastly, it is claimed by some writers that cases passing from tuber culoid into lepromatous or *vice versa* adopt temporarily the uncharacteristic histology

While this classification is acknowledged as an improvement on previous attempts it raises two obvious objections —

1 The third type covers three or it may be said five different kinds of lesions These may agree in their tatic histological structure and perhaps to a certain extent in their static clinical features but they disagree in the direction the case is going The answer to this objection is that only the static con dition of the case can be recorded at any one time the direction will be recorded as changes are noted on successive examinations
2 A classification based on histological structure requires laboratory facilities and expert personnel not available to the ordinary doctor who has to diagnose and classify leprosy cases The answer is that this is true but that the doctor must use simpler methods—clinical signs bacteriological smears and the lepromin test—in making his classification These methods however, must be based as far as possible on the histological structure which is the final court of appeal in any case of doubt Anyone with moderate experience can, with the help of the three simpler methods, classify with accuracy on a structural basis the great majority of cases

This classification is not entirely satisfactory, but it is a

distinct step forward and has cleared the way for further improvement and elucidation

The following table gives in parallel columns the dis tinguishing features of each of the three types These features are discussed fully in the remaining chapters of Part I

TABLE II

Main Signs in Basic Classification

F ms of Examinat	Lepromatous	Uncharacterti tic	Tuberculo d
H t fath logy f sk n ner elc	Lep a cell surrounded by lympho d cell c llular fo mation comp ativ ly loo e nerve infiltrat on sl ght or n l	Small round cell nfiltration as in oth r ch on in flamm t ons	Ep thel id and g nt c lls urround d by lympho d cell n f ll cles Denser cell lar form ti n Ner es mo e n filt ated
B ter fy	Posit + to + + + + cord g to degree of sev ty o d a me t	Sl ghtly po t ve + or negat	Gen r lly negat l os ti + in acute *exacerb t n*
Cl n al—			
Circumscr bed ski l le n	M t les mult pl and symm tr l smooth red or blanch d l ghtly ra ed ntre fad ng m rg n co l escing Anæsthesia light	Flat r d or bl ch ed ma g n not r ed may be diff cult to see mooth	Leprides gener lly a ymm tr al few b t occa nall many C erally ra sed margin th tuber les flat centre Anæsthes a no e m rked
D ffuse lesi n	Red an l o blan hed th t b c m ng th k n dule late	As abo	Atroph nd bla ched with m rg n as b e
N rves	M y be l ghtly thick ned a d t nder mor so t owar l la t tag	M y be sl ghtly th ck ed a d t nder	Often much th ickened n l t d a m times caseat n and bscess f rm tion
T lyneur l gns— n ha d nd f t	Get erally absent t first ften ppea ng nd p ogres g n f r-ad n ed a es	Oft n marked i i advanced cases	May be marked f m th beginning Sev re in all pro- gress ve cases
— n l d	Thicken g f fa e a d ears nod les le t asia		Mask face l goph th lm ll c d l ps
yes	C njunct t k r tit d vel t f xed p p l l l l es		Lag pt d l and w t t es pus k rat t c
Lepromin T t	Neg t	W kly p s t v r neg t e	M derat ly or tr ngly p t

clearly indicate the type which will ultimately evolve, and one which may even be difficult to distinguish from that of other chronic inflammatory non leprous conditions Hence the term *Uncharacteristic*, which is applied (Chapter Ten)

This type also includes residual cases in which during resolution but before complete healing the characteristic histological picture has been lost There are also cases of what might be called arrested development, with lesions which increase in size but continue to hold their early uncharacteristic chronic inflammatory structure Lastly it is claimed by some writers that cases passing from tuberculoid into lepromatous or *vice versa* adopt temporarily the uncharacteristic histology

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This classification is not entirely satisfactory, but it is a

distinct step forward and has cleared the way for further improvement and elucidation

The following table gives in parallel columns the distinguishing features of each of the three types. These features are discussed fully in the remaining chapters of Part I

TABLE II

Main Signs in Basic Classification

Form of Examination	Lepromatous	Uncharacteristic	Tuberculoid
Histopathology of skin, nerves, etc.	Lepra cells surrounded by lymphoid cells, cellular formation compact, loose nerve infiltration slight or nil	Small round cell infiltration and other chronic inflammation	Epithelioid and giant cells surrounded by lymphoid cells, follicles. Denser cellular formation. Nerves more infiltrated
Bacterioscopy	Positive [illegible] to [illegible] according to degree of severity or advancement	Slightly positive or negative	Generally negative. Positive [illegible] in acute [illegible]
Clinical—			
Circumscribed skin lesions	Macules multiple and symmetrical, smooth, red or blanched, slightly raised, with fading margin, coalescing. Anæsthesia slight	Flat, red or blanched margin not raised, may be difficult to see, smooth	Leprides generally asymmetrical, few, but occasionally many. Generally raised margin with tubercles, flat centre. Anæsthesia more marked
Diffuse lesions	Red and/or blanched, thin, becoming thick and nodules later	Absent	Atrophic and blanched with margin as above
Nerves	May be slightly thickened and tender, more so towards late stage	May be slightly thickened and tender	Often much thickened and tender, sometimes caseation and abscess formation
Peripheral signs—in hands and feet	Generally absent at first, often appearing and progressing in far advanced cases	Often marked in advanced cases	May be marked from the beginning. Severe in all progressive cases
—in head	Thickening of face and ears, nodules, leonine [illegible]		Marked facial lagophthalmos, flaccid lips
—in eyes	Conjunctivitis, keratitis, iridocyclitis, fixed pupil, blindness		Lagophthalmos and sometimes [illegible] keratitis
Lepromin Test	Negative	Weakly positive/negative	Moderately to strongly positive

SUB CLASSIFICATION

In addition to classification into one or other of the three basic types each case should again be sub classified according to the various details that are gathered in case taking (p 102)

The Pan American Congress (1946) approved the following clinical sub classification —

TABLE III

Type	Clinical Sub-groups
Lepromatous	Macular Infiltrative (diffuse) Nodular Neural Generalised
Uncharacteristic	Macular Neural Neuro macular
Tuberculoid	Macular Papular Neural Maculo neural Reactionary



Chapter Seven

Lepromatous Type

Etiology

THIS is the severe type of leprosy The patient has low resistance his tissues form a fertile soil for the growth of infection and in consequence the bacilli multiply and spread throughout the body

The disease is systemic but the chief clinical signs are in the skin and mucous membranes and to a less extent in the peripheral nerves (p 44)

The signs of leprosy are chiefly dependent not on wide spread toxins but on the local reaction of the tissues to the bacilli in their neighbourhood The nature of this reaction is obscure but it appears to be of an allergic nature (Chapter Five)

The distinctive feature of the lepromatous type is anergy The absence of an unknown factor which has the power to induce timely and effective reaction This absence has three important results —

(*a*) The only agent which could arrest the growth and spread of bacilli is in abeyance or it is too weak to be effective or it comes too late

(*b*) There being little or no reaction the signs of leprosy are wanting or obscure and the disease may advance far before it is recognised

(*c*) When at last tardy reaction does take place widespread skin lesions appear corresponding with the distribution of the bacilli but by that time the infection has dug itself in and reaction is no longer effective in checking or localising it

Clinical Course in Skin

The initial site of entry of infection is generally obscure only occasionally can it be recognised After entry the bacilli multiply in an unknown reservoir from which after an indefinite period, they are broadcast throughout the body This results in the creation of multiple foci particularly in the skin but often there are no immediate clinical signs Skin foci form centres from which bacilli gradually penetrate the surrounding skin and sooner or later, as delayed tissue reaction occurs they become clinically recognisable as multiple nodules or macules pink and/or pale in colour

These signs may at first be fugitive coming and going at intervals or standing out only when the skin is flushed by exercise, heat or emotion But gradually they become more permanent and are accompanied by slight thickening of the skin

Sometimes, and in some countries more frequently than in others early lesions of the tuberculoid or uncharacteristic type precede the lepromatous type (Fig 4) Doubtless these occur more frequently than is realised, and may often pass unrecognised Indeed some authorities state that it is the rule rather than the exception for tuberculoid lesions to precede lepromatous ones (pp 66 110)

Stages

The course of lepromatous leprosy, once it has become established and recognised may be divided into four stages which however, overlap each other

(*a*) *Macular*—Macules vary in number from a few to multiple They are circular or elliptic vary in diameter from 0 5 to 5 0 cm or more tend to be slightly raised in the centre and fade off into the surrounding skin at the margin They show pink in a light skin and pale as well as pink or coppery in a dark skin There is only slight loss of sensation They tend to increase in size and, where there are many in one area to coalesce (Fig 17)

(*b*) *Diffuse or Infiltrated*—As macules join together they form larger areas of diffuse infiltration which gradually spread through the most of the skin The parts which as a rule remain

DIFFUSE LEPROMATOUS THICKENING



FIG 5

Thi ken ng of f ce w th be g nning of le ntiasis and loss of yebrows



F G 6

Thicken ng of fac with flattened nose and of lp w th c mpl t alope



FIG 7

D ff infilt atı n of th abd m n w th p om nent km m king and th b g n n ng of nodulat on

FIG 8

El phanto d th k n ng of l gs



longest exempt are the mesial regions of the trunk front and back (Fig 17), and the flexor aspects of the elbow axilla groin and neck The colour is similar to that of macules, but there is a gradual tendency for the infiltration—no longer able to spread horizontally parallel to the skin surface—to penetrate deeper and cause more thickening This is recognised by picking up the skin between finger and thumb (Figs 5 to 8)

(*c*) *Nodulation* —While thickening may at first be diffuse and regular, there is a tendency sooner or later for irregular thickenings to protrude in the form of either nodules or localised broader patches The forearms, legs face and ears being the most exposed parts of the body and most liable to injury are those most affected The lion like appearance of the face (leontiasis) is well known Nodules may be sessile or pedunculated (Figs 7 and 9 to 12) They may be crowded together or widely distributed The reason for nodulation is obscure but its location is to a certain extent determined by exposure to injury or by the scars of previous skin diseases

Thickening and induration may extend into and similarly affect the subcutaneous tissue At times there are subcutaneous nodules or indurated areas which feel under the movable covering skin like patches of sole leather

(*d*) *Ulceration or Resolution* —At this stage nature shows a tendency towards eliminating bacilli either by discharging them through the skin surface or by absorption

In some cases, especially those complicated with acute exacerbations, there is a trend towards liquefaction and bursting of nodules or the covering epidermis of nodules and thickened patches breaks down under internal pressure leaving a raw ulcerating surface This raw surface is apt to become septic and the indurated base may take long to heal

In other cases resolution takes place without ulceration, and there is a tendency for the disease to limit itself and die out if the patient does not succumb to some complication during the process

Other Skin Changes

These are sensory alterations of various kinds and trophic changes in the epidermis, hairs and sweat organs

Sensation —Sensory changes in the lepromatous type are

LEPROMATOUS NODULATION



Fig 9

ιod lat n of posed part — f d upper l nb



Fig 10

Coarse th k ng of hand a d ped nc l ted nod les of fi gers



Fig 11

R ng f nodules d p pules suddenly appe ring in ide th p e d g marg n of hypop gm nted macul



Fig 12

Th ck n g and nodul t f ear a d p duncul t nod l of face

longest exempt are the mesial regions of the trunk front and back (Fig 17) and the flexor aspects of the elbow, axilla groin and neck The colour is similar to that of macules, *but there is a gradual tendency for the infiltration—no longer able to spread horizontally parallel to the skin surface—to penetrate* deeper and cause more thickening This is recognised by picking up the skin between finger and thumb (Figs 5 to 8)

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LEPROMATOUS NODULATION



FIG 9

dul t on of exposed p rts—
f ce nd uppe l mbs



FIG 10

Coars th kening of hand nd peduncul ted nodules of finger

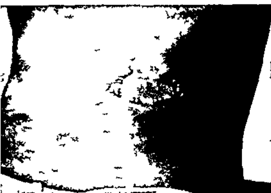


FIG 1

R g of nod l and p pules sudd ly appear ng ide th p ding marg n f a hypop gmented mac l



FIG 12

Th ken ng nd nod l t on of ea and ped ncul ted nod les of face

much less than in the tuberculoid except when secondary changes in the hands and feet intervene in the later stages Tactile sensation is lost only to a slight degree but pain and thermal sensation become more definitely absent as the disease advances (p 81)

Trophic Changes—Leproma especially in acute exacerbation, causes marked swelling of the skin and pressure on the



FIG 13

Compensatory hyperidrosis in patient with anidrosis of the limb



FIG 14

An invisible early leprous lesion The abdomen is covered with miliaria (prickly heat) following excessive sweating except in the anidrotic leprous lesion in the left flank which is exempt The circle in the centre is tinea flava

epidermis but when these resolve and subside they leave the skin and especially the epithelium, atrophic and wrinkled like a deflated child s balloon or crushed parchment This is further increased by the destruction of the elastic fibres in the skin

A similar process induces atrophy of the hair follicles and sweat organs causing deformity or destruction of hair and suppression of the sweat function The loss of hair is most noticeable in the eyebrows beginning laterally and spreading mesially Also in some cases there is partial or complete alopecia (Figs 5 6 9)

The loss of sweat function is most marked in the limbs indeed there may be compensatory hyperidrosis in the face and trunk Figs 13 14)

Changes take place in the nails similar to those in the hairs The pressure of leproma on the nail beds especially during prolonged reactions results in deformity of the nails with longitudinal ridging and a tendency for them to become shorter and even disappear altogether This is in marked contrast to tuberculoid secondary lesions where the softened fingers may shorten till the nail is at last perched on the head of the metacarpus

Secondary trophic changes in the hands and feet are described in Chapter Eleven

MUCOUS MEMBRANES

Next to the skin the mucous membranes are most seriously affected in the lepromatous type The lesions are very similar in nature to those of the skin

The mucous membranes involved are those of the nose mouth pharynx and the respiratory passages down to the larger bronchi The lungs and the gastro intestinal tract from the top of the œsophagus downwards are exempt

The nose may be infected comparatively early and it is often possible to find bacilli in scrapings from the septum before there are any recognisable clinical signs In advanced cases there is considerable thickening of the mucosa with nodule formation and ulceration Often the cartilaginous septum is destroyed but seldom the bony septum unless there is the complication of spirochætal infection This and the contraction following ulceration cause depression of the lower part of the ridge (Fig 6) Nodulation and the crusts covering ulcers often cause great distress by blocking respiration Septic infection is apt to spread to the eye especially after blocking of the lacrimal or nasal duct

The mouth seldom shows signs before the skin has been severely affected Later there is infiltration of the palate and tongue often followed by nodulation Ulceration of the fauces and glottis followed by contraction causes the typical

hoarse voice and later, dyspnoea Dyspnoea is of the inspiratory type not expiratory as in asthma

The trachea and larger bronchi may be the site of infiltration and large nodules These sometimes liquefy and burst especially during an acute exacerbation, a quantity of pus rich in bacilli is expectorated occasionally leading to a false diagnosis of pulmonary tuberculosis (p 98) (Lie 1936)

LYMPH NODES AND INTERNAL ORGANS

The lymph nodes act as filters for bacilli and in the earlier stages help to arrest bacilli before they pass up the lymphatics into the blood stream Apart from septic complications they are not enlarged to the extent that they are in tuberculosis Lymph node puncture is sometimes used as a help to early diagnosis (p 85) Caseation and liquefaction do not take place as in tuberculosis



FIG 15
Gynecomastia in three male patients

Internal Organs —The testicle is the only internal organ to be attacked and damaged and destroyed This is occasionally followed by gynecomastia (Fig 15)

The liver and spleen are sometimes enlarged temporarily during an acute exacerbation but ordinarily they give no clinical signs or symptoms and the functions of the liver are seldom interfered with

NERVE INVOLVEMENT

In lepromatous leprosy nerves contain numerous bacilli but have little tissue reaction hence symptoms are comparatively slight Loss of tactile sensation is often difficult to elicit but analgesia is more definite The first cutaneous signs are

sometimes preceded by symptoms of neural nature—tenderness and thickening of nerves with areas of lost sensation on the arms and legs These symptoms may persist even after lepromatous lesions have definitely established themselves thus producing what used to be known as *mixed* leprosy

In the later stages when resolution is beginning to occur neural symptoms generally become evident and there is loss of sensation often extensive and accompanied by deformities (see p 68) This is perhaps the more common cause of mixed leprosy

MORBID ANATOMY

Skin —It is easier and more profitable to study the pathology of leprosy from biopsy than from autopsy material The



F G

S t n f nodul Not the l y ppear f th l p ell to th left of the c p ll r wh ch ent g p p lla ho the b-ep d m l l y f f om c ll St n H & E (340)

former is readily obtained and the growth and variations of lesions can be studied in correlation with clinical signs Death

is often preceded by some complicating disease which alters both macroscopic and microscopic appearances, in the study of autopsy material this should be kept in mind

A piece of skin is taken from the edge of a macule including healthy and affected tissue Sections show a few bacilli around the sub papillary plexus and its papillary branches There is lymphoid cell infiltration round these vessels Examining the macule end of the sections there may be deeper infiltration round the hair follicles and sweat organs In suitably stained sections the cutaneous nerve branches may be seen sometimes surrounded by infiltration but not themselves infiltrated (Fig 19)



FIG 17

Spread ng lepromatous macule over ch t and abdomen Note fading errat d marg ns con flu nce of macules to form d ffu e le i ns and that the middle l ne the la t to be aff cted

Lepra Cells—In a more advanced stage examining sections taken from a diffuse lesion the infiltration is seen to extend deeper in the skin Lepra cells may be seen sometimes arranged in follicles surrounded by small round cells In a Ziehl Neelsen stained section lepra cells are seen to contain globe shaped bodies—globi—filled or partly filled with red stained bacilli (Figs 1 ?)

Tissue stained sections show lepra cells with a vacuolated appearance hence the name foamy cell (Fig 16) (Mitsuda 1936)

The nature and origin of lepra cells are obscure Some have suggested that they are caused by bacillary blocking of lymphatics It is more likely that they result from intra cellular multiplication of bacilli Macrophages (histiocytes) ingest bacilli but not being activated they cannot phagocytose them instead they are themselves parasitised

The foamy appearance is due to lipoid or waxy material

which may have a nature similar to fresh bacilli as both stain with sudan III though the bacilli are more acid fast than the lipoid material It seems not unlikely that the lipoid is produced from the bodies of dead bacilli and forms a matrix *in which the still living or at least acid fast organisms lie* embedded

When the most advanced of lepromatous lesions the nodule is examined it is found in addition to lepra cells and



Fi 18

S t t tl p ding edg f a l p o n t u macul Not th t the f It t n h fly of m ll l mph d ll n d ng the norm l fib t e ro nd th p lomot m les Sta n H & E (8)

small round cell infiltration to contain a large amount of fibrous tissue much finer than the ordinary collagenous fibres of the skin Later this contracts and causes hardening of the nodule *which to begin with is soft and vascular The* hair follicles and sweat organs are often destroyed and the epidermal interpapillary spaces are flattened out

Immediately under the epidermis there is an uninfiltrated

layer with few cells but some fibrous tissue (Figs 2 16) In dark skins the melanin pigment which normally penetrates the inner layers of the epidermis is notably diminished

Even in advanced lesions the nerve branches in the corium although surrounded by cellular infiltration are themselves but little or not at all infiltrated , this is in marked contrast to the tuberculoid type

Nerves —If subcutaneous nerve branches are examined they may be found to contain from a few bacilli up to massive infection (Fig 19) Lepra cells may be found but the degree of cellular infiltration considering the number of bacilli is very slight

When the larger nerves are affected the histological picture is similar to that in the skin showing lepra cells and small cell infiltration New formation of fine fibrous tissue is often found in and around the nerve bundles Later these fibres may contract and strangulate the axis cylinders The degree of nerve involvement is however much less than in the tuberculoid type

Blood Vessels —The larger blood vessels are not affected to any great extent In the subcutaneous arterioles there is a perivascular infiltration but to a much less degree than in the tuberculoid type It is difficult to gather from ordinary biopsy sections the great degree of vascularity of lepromatous lesions as the vessels collapse in the process of preparation Bacilli are found in the endothelial cells especially in the papillary end loops These are best seen in the spreading margins of well advanced lesions The position of these bacilli in endothelial cells is of much importance as it affords a probable explanation of how bacilli enter the blood stream (p 20) (Fite 1941)

Bacillæmia is common in advanced cases and especially during acute exacerbations Bacilli are found loose in the plasma but chiefly inside polymorph and monocyte cells

During the ordinary chronic course of leprosy polymorphs are rarely seen in lepromatous infiltration , but during acute exacerbations and in proportion to their acuteness the tissues become flooded with polymorphs We have seen this strikingly shown in a section through a lesion only the deeper



FIG 19
S t on f subcut n u n rve branch v th ma es of I p a b ll ly g betw n th ne e f b es Sign f cell l nfilt t n re ab nt



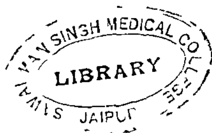
F 20
Th k d w ll f es el C ll c nt n ng b c ll e s n the wall d the end thel al lls of th v l at ( )

part of which was reacting In the reacting portion there was a massive polymorph invasion with but few bacilli remaining while in the non reacting portion there were many bacilli but polymorphs were absent

Mucous Membranes —Except for the distinctive features of mucous membrane the histological changes in lepromatous leprosy are similar to those in the skin

Internal Organs —With the exception of the testes the internal organs are not as a rule seriously affected at least as regards their function Bacillæmia implies that many bacilli must pass through or temporarily rest in their capillaries but active lepromatous follicles are not found to any great extent

In the liver and spleen the Kupffer cells and spleen pulp cells contain bacilli Fite and Gemar (1946) state that there may be five billion of these in the liver of a fairly advanced case, but that few proliferate to form miliary lepromata If it is remembered that a large proportion of these bacilli before reaching the liver must pass through the lungs and the walls of the stomach or intestines it is clear how resistant to infection these organs are Although we call lepromatous leprosy a systemic disease it appears that it is in reality a disease of the skin certain mucous membranes the peripheral nerves and the testes The internal organs are affected only incidentally and only for so long as these principal centres harbour the disease Indeed it would appear as if the liver spleen, lymph nodes and possibly the bone marrow act *chiefly as filters* and destroyers of infection



CHAPTER EIGHT

Lepromatous Type—*continued*

LEPRA REACTION

SYMPTOMS—The acute exacerbation which comes on suddenly in lepromatous cases causing general febrile symptoms and focal inflammatory signs—redness swelling œdema etc —is the most distressing and harmful condition *connected with the disease It must be distinguished from the* ordinary reaction of the tissues to bacilli described in Chapter Five

It seldom occurs before the infection has become generalised and fairly far advanced Local inflammation is chiefly in the lesions of the skin and mucous membranes though the peripheral nerves may also be involved and there may be swelling of the testicles liver and spleen and pain in the bones indicating that these organs are also affected



FIG 2
Acut l pra react n f the f

The entire lepromatous areas of the body may become simultaneously inflamed or reaction may at first be confined to lesions of only one part such as the face (Figs 21 22) other parts being affected later in succession Different layers of the skin and subcutaneous tissue may react at one time say the deeper layer first and the more superficial later (pp 42 44)

Lepra reaction may be slight and of short duration or it may be very severe with high temperature lasting for weeks

or even months, or the symptoms may come and go returning at regular or irregular intervals

In the severe form there may be exfoliation of the *epidermis*, or liquefaction and abscess formation in nodules and other indurated lesions Abscesses may burst and heal rapidly, or ulcers, often extensive in size may be formed and heal only with difficulty after the reaction has subsided



Fig 2
Subacute lepra reaction Note the swelling of face arms and hands

There may be simultaneous reaction in the mucous membranes with inflammation and ulceration of the nasal mucous membrane and swelling of the glottis causing aphonia and dyspnœa Nodules of *the trachea* may liquefy and burst discharging their pus in the sputum and there may also be *ulceration of the tongue* palate and fauces

Mild reaction on the other hand may cause only minor inflammatory swelling of lesions and the appearance of new lesions formerly not visible, it may occur with or without febrile symptoms

Ryrie (1938) found that the onset of lepra reaction was heralded by hyperalgesia of the soles of the feet elicited by stroking the plantar surface with a pencil or other hard instrument

Inciting Factors—Lepra reaction may occur in those who are *in good general health but it is more* common in those whose health has been depressed by complicated diseases by stress and strain, or by climatic conditions such as excessive

heat or cold It is infrequent for instance in the Owerri Province of Nigeria where leprosy is a very common disease but it was found much more frequently in African troops affected with leprosy returning home to this province from the war apparently the stress of military life had brought out lepra reaction Bowel conditions such as chronic dysentery and dietary defects such as vitamin deficiencies are particularly liable to provoke lepra reaction

Etiology—The mechanism of lepra reaction is obscure Some have suggested that it is due to rapid multiplication of bacilli and have stated that examination of lesions before and during its occurrence shows a marked increase in the number of organisms

Against this hypothesis there are the following arguments —

(*a*) Reaction comes on too suddenly to permit of the cause being multiplication of *M lepræ* (ordinarily a slow grower)

(*b*) In lepromatous leprosy there may be billions of bacilli in a small area of skin without any sign of lepra reaction

(*c*) The apparent increase in the number of bacilli may be due to the inflammation bringing the bacilli to the surface of the skin where they are more easily found

(*d*) Iodides administered by the mouth produce focal and general symptoms indistinguishable from lepra reaction within twelve hours or less after administration the signs gradually passing off after forty eight hours when the iodide is eliminated from the body How iodide reaction takes place we do not know but it can hardly be argued that iodides caused a sudden increase in the number of bacilli

It is more likely that lepra reaction is of an allergic nature but how it is provoked we do not yet know Bacillæmia is most marked during lepra reaction Experiments have shown that the intravenous injection of lepra bacilli does not induce

reaction so that bacillæmia is probably the result not the cause of reaction For a hypothesis connecting histamine with lepra reaction see Wharton's paper, p 136

The Role of Sepsis —While lepra reaction is primarily the result of sensitisation to *M lepræ* there is considerable evidence that septic organisms lodged in the devitalised skin or in open wounds complicate and aggravate the condition Further evidence is that acute reaction sometimes occurs in epidemic form spreading like erysipelas from patient to patient This is commonest in those hospitalised in old, dark and not too clean wards

The Threshold —Some patients are always on the verge of reaction , the least indiscretion of diet extra exertion or change in weather is sufficient to precipitate it Others require a much more serious inciting cause to bring it on It is convenient, therefore, to speak of the reaction threshold An important part of treatment is to raise this threshold, for a low level is an indication of activity of the disease

CHAPTER NINE

Tuberculoid Type

ETIOLOGY

THIS is the mild type of leprosy The patient is capable of developing resistance and to a greater or less degree the tissues by their local reaction limit the spread of infection

In some cases there is only one lesion and that may occasionally occur at what is obviously the site of inoculation One example of this was referred to on p 9 a barber who after shaving a lepromatous patient used to strop his razor on his forearm A single tuberculoid lesion developed corresponding closely with the area used as a strop and strictly confined to that area

The term tuberculoid is given on account of the histological resemblance of this type to chronic lesions in tuberculosis It is a somewhat unfortunate term as it is often confused with tubercular the word formerly used for the severe form now called lepromatous

When two or three lesions appear simultaneously on widely separated parts of the body or when they are multiple there can be little doubt that as in the lepromatous type there has been a reservoir where bacilli have multiplied and from which they have been disseminated

Thus the initiation of tuberculoid lesions is generally similar to that of lepromatous The chief difference lies in the greater resistance exerted by the tissues against the bacillus

CLINICAL COURSE

This depends on the degree of resistance and the ability of the body to produce timely and effective tissue reaction before infection has increased too much and spread widely

Abortive Lesions.—These can best be described by recounting three cases in the writer's own experience.

The first was a young man sent with a patch of anæsthesia on the back of the hand about 1 to 1.5 cm in diameter. A biopsy smear from this site showed no bacilli but a few acid-fast bacilli were found on excising and teasing out a small nerve branch supplying the affected skin area (p. 87). Sensation returned to the skin and the patient had no further trouble.



Fig. 23

Chronic partly burnt-out lepromatous case with widespread tinea infection masking the old lepra lesion. Note flattened nose.

The second was a youth who came with slight bending of the little finger and a feeling of heaviness in the left hand. There was no other sign. After excluding other possible causes the ulnar nerve sheath was split longitudinally above the elbow and a few nerve fibres scraped off. A few acid-fast bacilli were found on these fibres (p. 88). The left hand condition entirely disappeared and there were no later developments up to seven years later (Lowe and Chatterji, 1941).

The third case was a police officer who had been living in a malarious part of India and was in a debilitated condition. Several tuberculoid patches had developed on the limbs and chest. A change of climate and treatment for malaria led to disappearance of the patches and complete recovery.

These three cases are typical of many others in which the disease aborts either spontaneously, after some slight operative interference, or following improvement of general health.

Leprides

Skin lesions of the tuberculoid type, though they may spread until they have covered the whole skin surface, generally



FIG 24

Sect i f th k t berculo d les n N t f ll ul r gement g t ll fl tt ned p d rmis nd sub-ep d mal l y r compa t ely fr of c lls For f rthe m gn f t oi f ght low p rt ee F g 25 (80)



F 25

H gh m g f at n of r ght low r pa t of ect on sh wn n F g 24 th g nt cell a d p thel d c ll i f ll cular form t on (1000)

begin as separate more or less raised patches called "leprides". These vary in appearance and may conveniently be described in five forms, the first of these being the typical lepride.

1. *The Typical Lepride*.—The most characteristic clinical feature of the lepride is the "tubercle" not to be confused with the nodule in the lepromatous case. The tubercle is about the size of a pin head, is slightly raised above the surface



Fig 26 Fig 27

Front and back of tuberculoid case with typical lepride. Note raised margin, healing flat centre, serrated edge, small "pioneer" tubercles in advance of spreading margin. Note lesion of face invading brow and upper lip and centred on the nose.

of the skin and generally red or darker in colour than the surrounding skin.

An early lepride may consist of one or more tubercles but, more commonly, by the time tissue reaction takes place and the first lesion becomes a clinical entity it has attained a large size and appears as a mosaic of tubercles many of which may have coalesced to form an even elevated patch (Figs 30, 31).

Later, as the lepride increases in size, flattening to the skin level takes place at the centre so that the margin alone



Fig 28
Re cting tube ul d (Fo m 4 lep d) of the f
N t d fin te lower m g n on t mple and ch k

remains outstanding as a ring Sometimes a few pioneer tubercles are seen outside the ring ahead of the advancing edge

Taking this then as our typical lepride we have three zones a tessellated margin of tubercles an intermediate thickened hyperchromic area of coalesced tubercles and a flattened atrophic centre which is generally paler than the normal skin (Figs 26 27 33)

The margin but particularly the centre has a varying degree of anæsthesia

The Lepride with Thin Red Margin —This form may show no definite tubercles only a very thin reddish margin the



Fig 29
Th k n d med n utan
nerv f the f earm The l wer
pa t f the f earm h a l p d
m l to th t n f ont f th lbow

FI\E TUBERCULOID LESIO\S



Fig 30

Three leprides com po ed of fine tubercles which have not run together and with no flattening in the centre (Unusual form)



Fig 31

Leprides more raised and distinct than the la t com posed of fine tubercles and with slight central resolution (Form I)



Fig 32

\dvanced tuberculoid where numerou confl ent lep des have formed a les on covering the whole back except for a few darker areas of no mal skin \ote th rough tubercular formation al o the n rrov ra sed serrated m gin nd at ng act e sp ead

TUBERCULOID LESIONS



Fig 33

Typ c l lep id co le cing and flattening t th ent (Fo m 1)



Fig 34

Tubercles of penis a d scrot m (Un ual fo m)



Fig 3



Fi 36

Fig 35—Num o m ll nular l p d u t g (Form 3)

Fig 36—F w l g n ula lep d On u h l p de ha pre t lv p ad o r the f ce cau ng flac d l p d m k f a d l gophth lmo (F rm 3)

elevation of which the finger palpates only with difficulty The centre is flat slightly atrophic, anæsthetic to a varying degree and particularly in dark skins is paler in colour than normal Such a lesion will sometimes almost imperceptibly pass over the face leaving behind the triple sequelæ mask face lagophthalmos and flaccid lips (Figs 37 to 40 see also p 71)

3 *The Lepride with Broad Red Margin* —This is very similar to the last only that the margin is broader Tubercles are as a rule absent or inconspicuous (Figs 35 36)

4 *The Uniformly Raised Lepride* —This has no flattened centre for the whole area is raised This form is probably caused by reaction taking place uniformly and simultaneously over the whole area after the infection has already spread to a considerable diameter and fairly deep into the skin Reaction may or may not occur with sufficient strength to arrest further spread (Figs 28 54)

In the first three forms described above reaction is not sufficiently strong to arrest the spread Thus there is a continued centrifugal advance of infection with the tardy reactive and phagocytic power chasing behind, destroying the rear but failing to overtake the vanguard of the advancing bacillary army

The uniformly raised lepride is sometimes the site of a very severe reaction (see p 44) so much so that cutaneous ulceration may take place or there may be subcutaneous liquefaction Such a condition generally results in destruction of bacilli and spontaneous healing with scar formation (Fig 44)

5 *Multiple Leprides* —So far the leprides described have been single or only a few though by their gradual centripetal extension or by later additions to their number they may cover most of the skin surface

Multiple leprides appear simultaneously and—unlike the other groups—symmetrically as innumerable small strongly reacting nodules or plaques (Figs 41 to 43) If as in the fourth group reaction is sufficiently strong this form also may be self healing otherwise after a time it begins to spread and the margins of the many closely placed leprides soon meet and coalesce

FLAT TUBERCULOID LESIONS WITH NARROW MARGIN (F m 2



F G 37

Hyp p gm nt d lep d f t w tl fin ma g n Tl a l n lly pp h tl n h t r t typ



F 38

Ca n l to the la t w th larg l n of th houlder



F 39

Hypop gm nt d l n f l ft d of ch t th f n m rgin formed of m ut t b l



FIG 40

F bl cl ed by les o pt upp p t of b w d l ft t mple Th l n l l s ly app oach th unch ct t c type

Larger Lesions

These generally originate by the confluence of leprides One or two large patches may cover almost the whole body (Fig 32) Indeed the small unaffected area darker in colour has sometimes been mistaken for the lesion, and the once affected but now resolved skin for the normal area Clinically the skin is similar to the centre of the first three forms of lepride described above

Other Characteristics

Tuberculoid skin lesions have certain common clinical characteristics whether they be leprides or larger areas formed by the confluence of leprides These are —

(*a*) Sensory changes in tactile sensation (increased or diminished), and in pain and thermal sensation (see pp 80 81)

(*b*) Changes in the skin markings such as tubercle formation changes in the thickness and texture of the skin surface hyperkeratosis or parakeratosis trophic changes and scarring

(*c*) Deformity or loss of hairs

(*d*) Dryness and suppression of sweat (Fig 14)

(*e*) Changes in colour, due to diminished melanin pigmentary deposit dilatation of capillaries etc

These characteristics vary in each case with the form of the lesion the degree and duration of past or present reaction the colour and texture of the skin and many other factors

Activity of Leprides

Leprides and also larger tuberculoid lesions may show activity of two kinds which must be carefully distinguished The one is activity of the tissues and is really reactivity to the bacilli present in the lesion This is described on p 18

The other is activity of the bacilli and their proliferation and spread through the surrounding tissues The only clinical indication of this is the marginal spread of the lepride the fact that the margin is advancing and the rate of advance

can be judged by making measurements or a tracing and comparing the change of size after a few weeks or months

But a useful immediate indication is found in the shape and nature of the margin If it is irregularly serrated or amœboid—like the margin of an advancing amœba or like water spreading on a horizontal sheet of glass—this is a sure sign of activity If the margin is smooth and round like an amœba cyst it is inactive (p 123)

When the margin becomes flat and atrophic as does the centre in many leprides we have our best clinical indication that it is not only inactive but the bacilli have been destroyed The greater the tissue reaction previous to the flattening the more reliance can be placed on this sign

MUCOUS MEMBRANE AND OTHER ORGANS

Unlike the lepromatous type the mucous membranes are little affected except occasionally that of the nose The testis and internal organs show no clinical signs There are occasionally enlargement and tenderness of the lymph nodes during acute tuberculoid reaction or due to some septic complication

NERVE LESIONS

Nerve lesions are much more marked in the tuberculoid than in the lepromatous type There is frequently thickening and tenderness of sensory branches associated with leprides especially where they run in the superficial fascia for some distance before piercing the deep fascia The commonest sensory branches to be affected are those of the radial ulnar median anti brachial auricular and superficial peroneal (Figs 29 49 and 51 to 55) Thickening may go on to caseation and liquefaction and single or multiple nerve abscesses may be formed in sensory or mixed nerves (Fig 51)

For further discussion of larger mixed nerves and secondary multiple neuritis lesions of hands feet and face see Chapter Eleven

MORBID ANATOMY

Skin—In typical cases the histological picture of the tuberculoid lesion is very different from that of the well established lepromatous lesion The so called epithelioid cell

takes the place of the lepra cell and bacilli are absent or found in one s or two s instead of in thousands The epithelioid cell is so called because of its resemblance to cells of the basal layer of the epidermis

If a biopsy section is taken at right angles to the active edge of a typical lepride so that it includes affected and clinically unaffected skin and goes deep enough to include subcutaneous tissue, the following observations may be made —

(*a*) Stained with Ziehl Neelsen bacilli may not be seen or be found only after long search They are sometimes found in the thickened subcutaneous nerves more easily than in the skin

(*b*) With a hæmatoxylin and eosine or other tissue stain and beginning at the end of the section farthest from the centre of the lepride the tissues may be normal or there may be slight superficial cellular infiltration around the sub papillary vascular plexus Working towards the other end of the section there is gradually more infiltration passing down from the superficial plexus along the hair follicles and sweat organs to the subcutaneous plexus

(*c*) Examining the part of the section corresponding to the thickened edge of the lepride the whole or most of the corium may be composed of granuloma formed more or less distinctly into follicles These are circular or cord like areas with epithelioid cell and sometimes Langhan s giant cells at the centre surrounded by large numbers of small round lymphocyte like cells The follicles are separated from each other by the remains of collagenous fibres (Figs 24 and 25)

(*d*) The follicles may press on the epidermis flattening out the papillæ and interpapillary spaces and at the same time causing projections of the epidermis which are described clinically as tubercles

As in the lepromatous type there *is sometimes though perhaps less frequently* an uninfiltrated layer with few cells (pp 4° 67) immediately below the basal cells of the epidermis (*Fig* 24) Special

significance has been given to this layer by Cochrane (p 67)

(*e*) If the section has been stained so as to show cutaneous nerve branches these will be seen to be infiltrated more and more in passing from normal to affected tissue

(*f*) The subcutaneous neurovascular plexus and the branches which connect it with the larger nerves and vessels will be seen to be surrounded with cellular infiltration The subcutaneous nerves may show few recognisable axis cylinders the bundles being fully packed either with lymphoid cells or with a follicular formation similar to that in the corium

(*g*) It will be noticed that the cellular formation in both skin and nerve is much closer firmer and more clearly circumscribed than in the lepromatous type Earlier lesions are more vascular and richly supplied with capillaries as they become older they develop more fibrous tissue which contracts and hardens

Nerves —Branches in the skin and connected with the skin in subcutaneous tissue have already been described

The larger sensory and mixed nerves are affected in a similar manner There is the same follicular formation with epithelioid and giant cells centrally surrounded by small lymphoid cells

The whole thickness of a nerve may be affected or only one of two bundles Part of a bundle may be infiltrated leaving a few healthy nerve fibres at one side

There may be considerable thickening of the epineurium forming a dense often tight capsule and of the perineurium between the nerve bundles

The giant cells may be particularly large and several may join together giving rise to a caseous mass which may later liquefy and form an abscess similar to the lymph node caseation and abscess formation in tuberculosis (Figs 49 51)

A large neural abscess as that of the ulnar nerve just above the elbow may like an aneurysm be *fusiform* remaining inside the capsule or *dissecting* by piercing the greater part of the thickness of the capsule

There may be a series of *small caseous or liquefied nodes* along the course of a cutaneous nerve (Fig 51)

See also Wade s various articles

LEPRA REACTION

Description — This condition as it is found in lepromatous cases has already been described (p 45) But as there are some essential differences in the acute exacerbation occurring *in the tuberculoid type* it is explained here separately

There are two more or less distinct kinds of cases

1 Those with exacerbation in leprides of one of the first four groups (pp 50 to 57) Under the reaction they suddenly become inflamed and erysipeloid Affected nerves become *more thickened and often extremely painful especially* where they are superficial and liable to injury or pass through a rigid bony or fibrous canal (Fig 49)

If reaction is very severe there may be necrosis of cutaneous lesions with deep ulceration which will heal up only when the granuloma lining the base has been eliminated In deep lesions involving the subcutaneous tissue liquefaction may cause under mining of the skin over a considerable area In nerves both sen sory *and mixed caseation and abscess formation is often speeded up* by reaction Abscesses may also occur in affected tendon sheaths

An extreme example of tuberculoid reaction is what has been termed *lazarine* leprosy (p 102) when considerable necrosis of the skin and deep ulceration occur (Fig 44) (see Ryrie 1938)

Sometimes leprosy is first recognised when tuberculoid reaction suddenly appears Previously the lesions have been of the uncharacteristic or of a mild lepride form and have *escaped detection or been wrongly diagnosed* until they suddenly take on this acute phase which at once calls attention

2 The other kind of reacting tuberculoid is seen when the fifth group of lepride (p 57) takes on an acute form *Signs* may appear suddenly as a deep coarse scaly exanthematous rash covering part or almost the whole of the body Patches may be discrete or confluent The epithelium may break down but in any case lepra bacilli can usually be found under *or on the skin surface in considerable numbers*

Cases sometimes occur in which there is a mixture of these two varieties of reacting tuberculoid (Figs 41 42)

REACTING TUBERCULOID CASES



Fig 41

Sev e tuberculo d ea tion w th moderat ly str ng b ct olog cal find ngs



Fig 43

T ber ulo d ea t Note the le on ent ed ound the n e the asymmet c l ears a d the th ckeni g of all th les ons



Fig 42

The ame case afte a f w month with com pl te r t of the dis Not th sc r f rmat on



Fig 44

Very sever t be culo d act on wh h r ult d in ten e ul erat on (l z e lep osy) The ul ers ha healed with deep sc r f rmat on and ompl t arrest of th d se e

[illegible]

[illegible] —The [illegible] [illegible] [illegible] [illegible]

- [illegible] much less [illegible] [illegible] [illegible] and [illegible]
- [illegible] affected [illegible]
- [illegible] reaction [illegible] of the dis[illegible] [illegible] When [illegible] reaction the [illegible] and th[illegible] further [illegible]

I[illegible] [illegible] ordinary [illegible] [illegible] are few and difficul[illegible] to find, in reacti[illegible] [illegible] numbers, thou[illegible]h not [illegible] [illegible] the number found in lepromatous. B[illegible]t [illegible] a few days or weeks further examination may fail to fi[illegible] a[illegible]. Thus the reactive process, allergic or not is effective in destroying bacilli.

The tuberculoid type of reaction shows a trigger action—the power of the tissues to react is delayed for an inter[illegible] during which the bacilli, the explosive powder, multiply to a considerable, though limited, degree. When at last the tri[illegible] is pulled and the power set free, the reactionary explosion is violent and the bacilli disappear (in whole or in part) under the pent up phagocytic action of the cells.

The lepromatous reaction, by way of contrast, comes o[illegible] when the bacilli are generalised and have reached astronomi[illegible] numbers; the trigger is pulled but it fails to produce a sa[illegible] factory explosion, the powder only smoulders and the bacilli destroyed are more than replaced.

In other tuberculoid cases, though the reaction dies down, bacillary destruction is not complete, and sooner or la[illegible] lesions begin to spread at the margin.

In all cases, whether complete healing takes place or no[illegible] atrophy and scar formation is in direct ratio to the degree a[illegible]d depth of reaction.

CHAPTER TEN

Uncharacteristic Type

MANY cases on examination cannot definitely be placed under either the lepromatous or the tuberculoid type They have neither their clinical nor their pathological characteristics Accordingly they have been described in the Pan American classification as Uncharacteristic They may conveniently be divided into four divisions

1 INITIAL

These are early cases that have not yet had time to become determinate either as lepromatous or tuberculoid They may be in the balance ready to be tipped one way or the other

Clinical Signs —They are often difficult to recognise and are most commonly seen when the lesions appear on the face or when the patient is examined because of his contact with a known case of leprosy

They show one or more patches on the skin the margin of which is not raised or clear cut The only clinically diagnostic sign may be a hypochromic patch with rose coloured markings and slight changes in sensation Tissue reaction is slight and if it becomes marked it is usually a sign that the case has passed on into one of the other two forms When bacteriological examination is negative some cases are so clinically indefinite that but for the history of contact a definite diagnosis can not be made immediately (see p 181)

Morbid Anatomy —A few bacilli may or may not be found The histological picture is that of round cell infiltration surrounding the vessels especially in the superficial part of the corium In some respects it resembles the appearance

found at the spreading margin of a mild tuberculoid or lepromatous patch where infiltration has just begun

2 TERMINAL

Clinical—When the disease is resolving but has not completely healed the characteristic signs disappear Nodules become deep shining scars, thickened lepromatous skin becomes atrophic and like crushed parchment, tuberculoid lesions show light coloured flat areas Some of these lesions are still active though the activity is diminishing and they are therefore included in the terminal group

Morbid Anatomy—Bacilli may or may not be present in small numbers Sometimes ghost like globi are found which may have a few partly stained bacilli in them Fibrous tissue is generally found of a finer kind than normal collagenous fibres Its quantity is in proportion to the thickness of the former lesion and the degree of tissue reaction which preceded resolution The elastic fibres of the skin may be destroyed to a large extent

3 *UNDIFFERENTIATED*

These are similar to initial cases except that they remain undifferentiated and do not pass on to either of the polar forms In some countries, as in some parts of West Africa they seem to be particularly common

4 INTERMEDIATE (TRANSITIONAL)

It has already been mentioned (p 32) that the tuberculoid type sometimes precedes the lepromatous and some workers describe an intermediate stage when lesions are passing from the one type to the other Sometimes structural pictures indicative of both polar types have been found in one patient at the same time Inversely lepromatous cases have been described as changing into tuberculoid especially under sulphone treatment

Some workers have described a *Reacting Intermediate Group* different from the above It bears clinical resemblances to the lepromatous type but it is less virulent and sometimes

shows a tendency to self healing like the tuberculoid and yields to treatment better than the lepromatous

In lepromatous lesions which have advanced beyond the first stage a non cellular œdematous layer (pp 4? 60) is found immediately below the epidermis (Fig 2) A similar layer (p 60) is seen perhaps less frequently in mature tuberculoid lesions (Fig 24) Cochrane (1947) from his experience in South India considers that the presence of this band indicates that the case will pass on into the lepromatous type and that it is therefore of important prognostic value This finding awaits confirmation as to its significance in other endemic areas

Wade (1941) describes borderline cases which are in some respects the same as the reacting intermediate division of Uncharacteristic though they differ in that they show a characteristic histological picture Experience indicates that there may exist the paradoxical situation of a case with lesions that as far as can be identified by known criteria are histologically lepromatous but that may behave clinically like ordinary tuberculoid lesions This description has been confirmed by other observers

The whole question of transmutation is still obscure and needs considerably further study

The following figure of a three roomed house shows in diagrammatic form the various divisions which are classified under the uncharacteristic type —

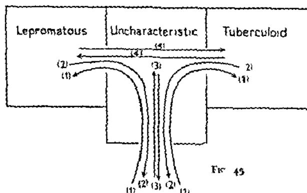


Fig 45

CHAPTER ELEVEN

Multiple Secondary Neuritis

UNDER this heading we have included the peripheral (polyneuritic) lesions of the hands and feet, which are not due to local infection with lepra bacilli but are secondary to blocking or destruction of the long nerves supplying these parts The atrophic condition of the facial muscles, secondary to infiltration of leprides passing over the face is also included

HANDS AND FEET

Secondary lesions of the hands and feet occur in all three types of leprosy, but are most marked in the tuberculoid Cutaneous lesions of the lepromatous type may be preceded by an attack possibly of a tuberculoid nature, on one or more of the large mixed nerves of the limbs Generally the ulnar or superficial peroneal is affected, resulting in permanent sensory and trophic changes in the corresponding hand or foot



FIG 46

Extreme polyneuritic lesions of hands and feet with disappearance of fingers and toes Yet this patient was able to work with the hoe and hatchet

But it is towards the end rather than the beginning of the course of the lepromatous case that this complication is most marked At this stage the thickened skin lesions in the face gradually diminish while the secondary anæsthesia and

deformity of the hands and feet slowly increase resulting in the well known mixed case (p 39)

In the tuberculoid type the secondary signs are much more marked Generally skin lesions (leprides or generalised patches) are also present or if they have healed they have left signs of their previous presence Occasionally no visible signs of skin lesions are found but careful mapping out of anæsthesia on the limbs will show patches of diminished sensation which do not correspond with the sensory distribution of the main nerves affected These rounded or oblong patches have been left by previous skin lesions now healed and they may partly overlap the secondary anæsthetic areas



F G 47

Comb nat n of m lnutriti n and e t m polyneur t les ns — ma k fac l g ph thalmo p of l p Th rp l a d tars l bones affected as w ll as thos of the d g ts

Mode of Nerve Invasion —There is evidence that although infection may reach the larger nerves directly through the blood stream the invasion is commonly from adjacent skin lesions by way of the sensory nerves (Figs 49 and 51 to 55) This is shown by the frequency with which branches of two separate nerves supplying a single skin area are both thickened no other nerves in the body being involved Thus with a lepride on the back of the hand ulnar and radial nerve branches at the wrist are thickened and the ulnar is thickened also above the elbow (Ermakova 1947)

The morbid anatomy in lepromatous and tuberculoid cases is described on pp 39 59

Clinical Signs —These vary according to the nerves affected and the degree of their involvement They are —

(a) *Anæsthesia* of the hands and feet or parts of them The ulnar and superficial peroneal nerves due to their exposed position are generally first and most affected and loss of tactile pain and thermal

sensation most frequently begins in their distribution

(*b*) *Atrophy of the Small Muscles* —This may be partly the result of anæsthesia as the finer movements of the hands and feet, normally performed by the small muscles are to a large extent abandoned by the patient as he can no longer feel himself doing them

Atrophy is however, chiefly consequent on removal of motor and trophic nerve supply The muscle fibres revert to primitive fibrous tissue, which in turn contracts causing deformities in the hands and removing resilience and their natural padding from the soles of the feet

Not infrequently the peroneal group of muscles in the leg are also atrophied When the muscles of the forearm are affected it is generally the result of immobilisation of the forearm on account of the pain of acute lepra reaction

(*c*) The *bones* of the hands and feet and especially those of the digits become decalcified and soft This is partly secondary to muscular atrophy and the removal of strain on the bones and partly from interference with the nerve supply Because of the softening of the bones of the digits they gradually become shortened under outside pressure Frequently this process is accelerated by injury or by the entry of septic organisms causing deep abscesses and necrosis of bone

In severe cases one or more of the metatarsals generally becomes necrosed and les frequently the tarsal bones and joints are involved

Hand —One of the first signs of secondary neuritis in the hand is anæsthesia and inability to straighten the little finger, along with a feeling of heaviness The patient is unable to abduct the little finger while keeping the other fingers approximated

Later there is wasting of the muscles of the thenar and hypothenar eminences and of the interspaces between the metacarpals which become hollow Then there is

hyperextension at the metacarpo phalangeal joints and flexion at the interphalangeal joints—constituting the well known claw hand (Fig 48)

Patients are often able to use their hands quite effectively even after the loss of their phalanges as the muscular supply from the forearm is unaffected

Foot —Perforating or trophic ulcer in the sole of the foot causes most trouble It is most commonly found at the points where the chief weight is borne while walking or standing especially at the head of the first metatarsal (Figs 64 65)

Trophic ulcers may be superficial affecting only the skin medium when the fascia and ligaments are involved or deep when there is necrosis of bone In cases of neglect abscess of the foot may occur

Foot complications have a very important bearing on the course of the disease as the patient is apt to become bedridden and demobilised during long periods and is liable to septic absorption from acute or chronic ulcers both of these are very harmful and tend to retard his general recovery



Fig 48

P lyn urit les ons — cl w hand ma k f l gophth lmo d flacc d l ps

Face —Fig 36 shows a mild type of lepride passing over the trunk A similar lepride has already traversed the face leaving in its train a certain amount of anæsthesia and the triple sequelæ of this kind of lesion—mask face flaccid lips and lagophthalmos (Fig 48)

In some cases there is a complete and sudden unilateral paralysis caused obviously by the bacilli spreading up the facial nerve and causing swelling and nipping as it passes through the stylomastoid foramen In mask face however there is a slowly

developing atrophy of the facial muscles, and it is difficult to account for this by the invasion of the motor nerve branches for why should the infection not spread up to the bony canal as in the cases just mentioned and cause complete and sudden paralysis? The alternative is that the muscular atrophy is consequent on the anæsthesia of the skin of the face left by the healed lepride



Fig 49
Paralysis of right side of occipito frontalis following nipping of thickened supra orbital nerve in passing through foramen

Paresis of the lips if marked, causes considerable inconvenience to the patient because of dribbling from the mouth (Figs 47 48)

Lagophthalmos is discussed in the next section

EYE INVOLVEMENT

The eyes are affected differently in the two polar types of leprosy In the lepromatous type there is bacillary invasion of the eyeball and granulomatous reaction similar to that in lepromatous lesions of the skin In tuberculoid cases there is no granuloma but when leprides pass over the face they frequently leave behind trophic changes in the muscles of the face including those of the eyelids The resulting lagophthalmos often leads to complications

Lepromatous

The incidence of eye complications varies considerably in different countries In Trinidad the author found the eyes were involved sooner or later in the great majority of lepromatous cases whereas in some parts of Nigeria he found it the *exception There was a corresponding difference* in the general severity of lepromatous cases in these two places

The eye seldom if ever shows clinical signs of leprosy until after the surrounding skin of the face and the nasal mucous membrane have become bacteriologically positive It is probable that in the majority of cases bacilli spread to the eyeball through the lymphatics from the eyelids and surrounding skin of the face though sometimes infection may take place through the blood stream, or even by direct infection through the front of the eye

The anterior segment of the eye is alone affected and if the posterior segment is implicated it is as a direct spread from a gross lesion of the anterior In this respect leprosy differs from syphilis and tuberculosis as it does also in the exemption of all parts of the central nervous system

As in the skin so in the eye infiltration may spread at a superficial or deep level or an initial superficial spread may pierce later to a deeper level (p 34)

Superficial —If the disease advances through the conjunctiva it is generally first noticed when it reaches the cornea Here it appears either (*a*) in the form of a punctate keratitis which should be examined for carefully with a loop and lens or (*b*) as a keratitis with pannus which gradually extends out from the limbus towards the pupil and which it may eventually cover



Fig 50

Lepromatous case with almost complete blindness caused by sclerosing keratitis Note also the ulceration of the nose and lips

Deep —The sclera and uvea are invaded chiefly along the line of the anterior ciliary vessels Leproma of the sclera encroaches beyond the limbus

either as an annular invasion of the deeper layers of the cornea or as a nodular extension followed later by sclerosing keratitis (Fig 50)

The invasion of the iris often escapes the attention of the patient for a considerable time because of its insidious and painless onset It also may escape the attention of the physician unless he specially looks for it In milder cases or those in which the disease is becoming extinct, there is plastic iritis and in severer cases there are nodules either single and large or small and miliary the latter appearing as a fine white powder on the surface of the iris In fact, in the lepromatous type the eye, and in particular the iris is a microcosm of the disease in the skin and mucous membranes The condition can be studied with a corneal loop or more satisfactorily with the corneal microscope The pupil reacts irregularly and only partially to light The irregular margin is shown up by the application of atropine

Later further serous and plastic changes may take place The pupillary edge becomes anchored to the lens by synechiæ When atropine is instilled the pupil is either found entirely fixed or dilates slowly and irregularly Exudate may occlude the pupil, or may be deposited on the back of the cornea or in the anterior chamber

Lepra reaction in the eye is one of the most distressing *conditions in leprosy If acute there may* be severe pain and intense photophobia while irreparable damage may be done in a few days

Tuberculoid

In this type the eye is seldom directly attacked though there may be considerable temporary congestion of the front of the eye if the eyelids and surrounding skin are the site of a reacting tuberculoid

The etiology of lagophthalmos as the sequela of a healed *tuberculoid lepride is described on p 72*

The inability of the patient to close his lids especially when asleep and a variable loss of sensation in the cornea partially remove the protective mechanism of the eyeball which is

thus subject to injury from dust insects and infection (Figs 47 48)

The lacrimal organs may also be implicated there may be diminished secretion and therefore less moisture and cleansing of the front of the eye The eversion of the lower lid also causes epiphora and interference with the drainage of tears through the nose

When the patient is asleep at night the eyes are turned upwards and the conjunctiva below the cornea and in severe cases the lower part of the cornea are exposed This may lead to chronic conjunctivitis and keratitis and if precautions are not taken to ulceration of the cornea and even destruction of the eye

PART II
DIAGNOSIS AND TREATMENT

CHAPTER TWELVE

Diagnosis

THE diagnosis of leprosy depends upon clinical and bacteriological examination the former being of most importance in the tuberculoid and the latter in the lepromatous type In doubtful cases histological examination and certain skin tests have to be undertaken

CLINICAL EXAMINATION

In medical science there are few more conspicuous conditions than that of a well developed lepromatous case recognisable even at a distance What few realise however is that a few months previously the same patient may have passed a medical examination without being suspected of suffering from leprosy or any other skin disease Yet at the time of that examination but before prominent nodulation and induration took place the patient may have been shedding large numbers of lepra bacilli from the skin surface and nose This is a fact which should always be kept in mind in endemic countries or in examining those who have been in such countries and where any suspicion exists a careful bacteriological examination should be made (pp 11 102)

The tuberculoid type with conspicuous lesions appearing on the skin surface is easily recognised by anyone who has previously seen a few cases and yet not only in England but in India Africa and the West Indies the writer has frequently found cases missed or wrongly diagnosed by experienced physicians sometimes even by skin specialists

Perhaps the most difficult of all to identify is the early uncharacteristic case particularly if the skin is light coloured in fact it is often likely to be missed unless suspected because

of former contact with a known case of leprosy Sensory changes may be absent or difficult to elicit especially in young children, and, unless examination is made in good light minor alterations in skin colour may be hard to detect Bacteriological examination may be negative, and in these cases the histamine and pilocarpine tests (p 89) are sometimes of value Examination of biopsy sections will probably show small round cell infiltration, but nothing characteristic of leprosy unless extension along the adjacent sensory nerves is found Even so, it is occasionally necessary to suspend a definite diagnosis till clearer signs appear

The clinical indications of leprosy are (*a*) visible and palpable skin changes, (*b*) sensory alterations either in visible lesions or in apparently normal skin, (*c*) trophic changes in the skin (sweat function, loss of hair etc), in muscles of the face hands and feet and in bones and joints of the hands and feet (*d*) thickening and tenderness of peripheral nerves

Visible and Palpable Skin Changes

These have already been described in Part I but may be briefly summarised here

Lepromatous—Red or pale macules not raised or thickened and therefore visible but not palpable, larger red or pale infiltrated areas formed by coalescing of macules, nodules and thickened areas

Tuberculoid—Leprides of the forms described in Chapter Nine and illustrated in Figs 26 to 40 differ from macules (Fig 17) in being raised and indurated at the margin or throughout

Uncharacteristic are described in Chapter Ten and are more or less ill defined patches with red or pale changes of colour or both

Sensory Alterations

These are tactile algesic and thermal There are many ways of testing for these conditions but it is well to choose the simplest and most objective so as to exclude errors dependent on the patient s imagination and prejudices Two

are here recommended the feather test for tactile sensation and the two pin test for pain

Feather Test—The patient is blindfolded preferably by depressing the upper eyelids with the left thumb and middle finger A light feather piece of cotton wool paper or grass may be used to touch the skin First normal skin is repeatedly touched the patient being asked to place his finger each time on the point of contact Then from time to time the suspected areas are touched and the response is noted whether light tactile sensation is present or not In this way anæsthetic areas may be mapped out

Two pin Test—This is often positive when the feather test is negative especially in the face also in all parts of the skin in lepromatous cases Two small pins of equal size and sharpness are held one in each hand With the patient blind folded two points of normal skin are pricked simultaneously and with equal pressure either on the same side or on opposite sides of the body and the patient is asked to say which if either is more painful then a normal and a suspected area are simultaneously pricked the results are noted after con firmation by several repetitions

Changes of thermal sensation are sometimes tested with hot and cold test tubes but this is more subjective and therefore more liable to error

The degree of anæsthesia and analgesia varies in different cases lesions and parts of lesions the inactive centre of a large lepride is often more numb than the active margin or than a smaller lepride Tuberculoid lesions are as a rule more insensitive than lepromatous Loss of sensation is often most marked in secondary lesions of the hands and feet (pp 70 71)

Trophic changes in skin muscle bone and joints have been described in Chapter Eleven

PERIPHERAL NERVES

The combination of thickening ar [illegible]ss peripheral nerves forms a [illegible] m diagnostic sign on which the final diagn other signs are indefinite It occurs in

form in which it can be mistaken for leprosy except in the very rare condition *hypertrophic interstitial neuritis* (see p 96) It may be present in all types, but is commonest and most marked in the tuberculoid type Thickened sensory branches may often be palpated subcutaneously when the skin they supply is the site of a tuberculoid lesion They are chiefly in the limbs face and neck, and on the back of the trunk (intercostal branches) Pressure elicits pain, tenderness or tingling, the last of these being both local and in the area of distribution Percussion on leprides often causes tingling

Of the larger nerves the *ulnar* is the most important The nerves on both sides should be examined simultaneously and compared from the elbow to the axilla Face the patient and make him extend his forearms supinated and slightly bent at the elbows the nerves can be palpated conveniently and relative thickness and tenderness determined



Fig 51
Thicken ng and nodul tion of medial cutaneous nerv of the forearm with lepride above it

Other nerves to be noted are branches of the *radial* lying on the radius just above the wrist the *medial cutaneous* nerve of the forearm the *auricular* in the neck from below the angle of the jaw to where it passes round the posterior margin of the sternomastoid the *superficial peroneal* behind the knee to where it passes round the neck of the fibula and the terminal branch of the same nerve in front of the ankle, the *sural* nerve in the calf (see Figs 49 and 51 to 55)

The degree of nerve thickening varies considerably It is either continuous or beaded like a rosary Caseation and softening with abscess formation may occur

THICKENING OF NERVES



Fig 52

Th ckened pe fi al p on l n rv nd t tw t rm l b hes th l pr de of th d rsu n



Fig 54

R act ng tub ulo d les on f ght fa e d ne k w th th ck n i g of th au i ula and trans e se bran he of rv al pl xu



F c 53

Tl k n d b an h f d al n v nd l p d f d um f h d nd n ddl nd ring fing r



Fig 55

Lepride b lo ear and tl k n ng of cular n rv

CHAPTER THIRTEEN

Bacteriological Examination

COLLECTING MATERIAL

IN routine examination smears are taken from the nasal mucosa and from the most outstanding skin lesion, failing the latter it is taken from the lobule of the ear Three or four smears may conveniently be made on one slide

Nose—In taking material from the nose do not use a swab Unless there is ulceration the bacilli are not on the surface but there are partially acid fast saprophytic organisms on the surface which have often been mistaken for *M lepræ*

A sharp pointed narrow instrument such as a tenotomy knife should be used Preferably with the help of a speculum a small piece of mucosa is scraped from the septum or turbinate taking as little blood as possible this is smeared on a slide

If material is taken from the lower part of the septum no anæsthetic is necessary, but when a previously positive finding has become negative it is necessary to take it from the septum up to 1½ in from the orifice, for this a speculum is necessary and the previous application of an anæsthetic (cocaine by swab or spray) is advisable

Skin—For skin examination care must be taken in selecting a site If there is no circumscribed lesion (lepride nodule macule etc) the point of selection should be the edge of the lobule of the ear If a lepride is chosen then the margin or the most swollen and inflamed part should be chosen Nodules almost always contain bacilli in considerable number

There are various methods of taking a smear but which ever way is used the skin should first be rendered bloodless by pressure

1 *Snip Method*—Snip off a small piece of skin with a

scissors curved on the flat lay the material with the epithelial side down on a slide and holding it with a forceps scrape off the soft corium with a knife and smear it on the slide

2 *The Slit Method* —With a sharp scalpel make a slit in the skin 2 to 3 mm deep scrape the tissue from the bottom of the wound with the point of the knife and with this make a smear

3 *Puncture Method* —Pick up the skin with a long bladed curved clamp and when the pressure has rendered it bloodless puncture the loop of skin deeply with a large bore injection needle in three places Serum will appear at the points of puncture from which smears are made It is claimed by some that this last is the most likely to show bacilli when they are few in number

4 *Cutting punch Method* —With a cutting punch biopsy forceps (Walter 1947) material may be sheared off easily and quickly either for making smears or for sectioning The deeper part of the tissue is smeared on a slide with a knife

The first method is more likely to show bacilli than the second but the second has the advantage of not removing epithelium and several parts of the skin surface can be examined at one time without undue inconvenience to the patient Multiple smears may be necessary when bacilli are few before pronouncing a case negative

Lymph Nodes —Lymph node puncture has been found by some to give positive results when nose and skin are negative A small quantity of sterile saline is drawn into a 2 c c tight fitting syringe The lymph node generally in the groin is held between finger and thumb of the left hand and punctured with the needle After injecting the saline suction is applied and the material extracted smeared on a slide

PREPARATION OF SMEAR SLIDES

Two methods of preparing slides are advised the ordinary method which requires less time and is good enough for ordinary purposes and Castro s method which takes longer but shows up bacilli more clearly

1 *Ordinary (Ziehl Neelsen) Method* —Fix immediately after the smear has dried by passing the slide rapidly through a

flame, smeared surface up Repeat till the slide feels hot but not uncomfortably so on the back of the hand

The following solutions are required —

(a) Ten per cent fuchsin (of reliable manufacture) in 90 to 95 per cent alcohol Five per cent crystalline carbolic acid in distilled water Mix the solutions in the proportion of 1 of the first to 9 of the second This mixture should be dis carded whenever it shows any sign of precipitation

(b) Ten per cent sulphuric acid

(c) Saturated alcoholic solution of methylene blue 30 parts distilled water 100 parts, 1 per cent caustic potash 1 part

Place a square of filter paper on each smear and drop solution (a) on the filter paper as much as will not spread beyond the filter paper Heat till the solution steams slightly and then stain for ten minutes

Wash in water and drop on (b) till red colour has almost disappeared on washing with water Wash thoroughly in water and add (c) Wash, after two minutes, and dry

2 *Castro's Method* (1947) —This has been found to show more bacilli than the ordinary method and is of particular use when they are few It also shows up the appearance of beading

The solutions required are —

(a) Carbol fuchsin mixture as above

(b) A 10 per cent solution of potassium phosphate (KH_2PO_4) with a small addition of calomel to avoid moulds

(c) Hydrochloric acid 3 c c ethyl alcohol (96 per cent) 97 c c

(d) Methylene blue 1 gm, water 1,000 c c

Add to 10 c c of (a) five drops of (b) just before beginning stain Flood the slide with stain and steam for five minutes Allow to cool until there is clouding and precipitation of the stain Pour the solution off the slide and without washing decolorise in (c) till no more stain flows off Counterstain with (d) for half to one minute

Halberg (1946) has also devised a method of staining with nachtblau with which he claims better results than with the Ziehl Neelsen method

Examination of Smears

Examine with $\frac{1}{12}$ oil immersion and a low ocular using a higher ocular if necessary to confirm findings

Tuberculoid.—Smears from a chronic lepride (p 50) often fail to show bacilli the greater the signs of activity and inflammation the more easily are they found In strongly reacting leprides (p 62) bacilli may be very numerous though seldom in the form of globi (p 6) but as activity begins to fade further examinations may prove negative

Lepromatous.—Macules generally show at least a few bacilli In more mature diffuse lesions bacilli are numerous and globi are often present while in nodules globi are many and bacilli appear in enormous numbers

As the lepromatous case progresses towards healing bacilli become fewer and those inside globi appear less stained

The *morphology* of bacilli varies a good deal according to the activity of the case and the staining of the film In lepra reaction the bacilli appear more granular and diphtheroid (bipolar staining) and uniformly stained forms are fewer With Castro's method beading shows up more clearly than with the ordinary method and the rods appear longer and more numerous

Uncharacteristic.—In initial and residual cases bacilli may or may not be found they are seldom in large numbers In intermediate cases the number found would depend on the nature of the transition A few bacilli may be seen in undifferentiated cases

Nerve Examination

In an early and doubtful case where the skin is negative and the clinical signs are localised but indefinite a small cutaneous nerve branch attached to the doubtful lesion may show bacilli A small piece of the branch is excised and teased out on a slide stained by the ordinary method and examined (p 50)

If a larger nerve is suspected of infection (pp 50, 96) the sheath of the nerve may be split longitudinally and a few fibres scraped off, teased on a slide and examined care being taken not to injure the nerve functionally It is very seldom that either of these procedures is necessary

HISTOLOGICAL EXAMINATION

The technique of histological examination is beyond the scope of this book and reference must be made to larger works (Gradwohl 1943, Holder 1931, Carlton and Leach, 1947)

It is important that in all cases of doubtful diagnosis or classification skin sections should be examined For collecting and despatching material for sectioning the following notes may be helpful

Removing Tissue—Using surgical precautions excise with a scalpel an elliptical piece of skin, cutting deep enough to remove subcutaneous fat with the nerves contained It is sometimes suitable to take the material from the edge of a lesion and to include some of the surrounding clinically normal skin If only a small piece of tissue is required it may conveniently be excised with a cutting punch forceps (Walter 1947)

Fixation—Pieces of tissue should not be more than 3 or 4 mm thick so as to allow penetration of the fixative Formalin should not be used as it interferes with the acid fastness of bacilli Use either Zenker s fluid or alcohol

(*a*) *Zenker s Fluid*—This consists of bichloride of mercury 5 gm bichromate of potassium 2 5 gm, water 100 c c Dissolve by heating Into 25 c c of this stock solution drop the material after adding 1 c c of glacial acetic acid (The acid should not be added in making the stock mixture) After fixing for eight hours wash under the tap or in several changes of water Place in 70 per cent alcohol and change after one or two days

(*b*) *Alcohol*—Place the material in 70 per cent alcohol 30 c c and change the alcohol after twelve to twenty four hours and again on the following day

Packing—Place the hardened material in a small bottle

or test tube between layers of cotton or gauze saturated in alcohol Seal the container and pack carefully with soft material in a box

SKIN TESTS

The histamine and pilocarpine tests are of help in very early suspected cases which are bacteriologically negative and show doubtful clinical signs

HISTAMINE TEST (Rodriguez 1933)

A drop of a *1 in* 1 000 aqueous solution of histamine is placed on the edge of the suspected lesion (half on and half off) another inside the margin and a third outside The skin is pricked with a needle through each of the drops deep enough to pierce the epidermis but not to draw blood In affected skin there is a triple reaction round the prick—an initial erythema a larger flare and a papule Carbonell and Duenas (1940) claim to obtain quicker and clearer results than with histamine by using *Priscol*

PILOCARPINE TEST (Degotte s method)

Inject intradermally into the suspected area 0 2 c c of a *1 in 1 000 solution of pilocarpine nitrate and the same into* normal skin Paint both areas with tincture of iodine and when this has dried dust on starch powder The sweat induced in normal skin will wet the starch and cause a blue colour with the iodine Absence of colour indicates the anidrosis of leprosy (Muir 1939)

Chapter Fourteen

Differential Diagnosis

Cardinal Points

Many signs and symptoms have been used in the diagnosis of leprosy but three cardinal diagnostic points should be kept particularly in mind in differentiating leprosy from other diseases —

(a) Finding of acid fast bacilli (smear from skin or nose)

(b) Sensory changes in the skin (feather and two pin tests) (p 81)

(c) Thickening and tenderness of nerves (p 82)

For those with limited experience it is convenient to have a fairly complete list of the many conditions which are mistaken for leprosy These are arranged in six categories each corresponding to a different diagnostic aspect leprides colour changes thickening and tenderness of nerves secondary neural signs the lepromatous type, other acid fast bacilli

It is worth remembering that one or other of the conditions mentioned may not only resemble but may coexist with leprosy and even mask and confuse leprous lesions (Figs 23 47)

1 Resembling Leprides or Macules

That is to say, round or oval patches in the form of plaques or rings with a tendency to centrifugal spread

(a) *Seborrhœa*.—This disease beginning in the scalp often spreads downwards in shower bath fashion to the face and trunk It is most conspicuous in fair skin seen as patches slightly white or with a yellowish centre and a reddish slightly inflamed margin It causes little or no irritation *Seborrhœa corporis* is in the writer s experience one of the commonest causes of leprophobia (p 98)

Close inspection shows it to be on the surface and not like a lepride inside the skin. The three cardinal points are negative and the seborrhœal condition of the scalp and shower-like distribution are generally characteristic.

(*b*) *Psoriasis*.—The writer has on several occasions found this disease misdiagnosed for leprosy. With its red annular margin it sometimes appears like an acutely reacting first form of lepride, while when more scattered it closely resembles the fifth form (pp. 52–57).



Fig. 56

Psoriasis mistaken for diffusely attacked tuberculoid leprosy. Note the nature of the scalp condition.

The scales of psoriasis are finer and more silvery than those of a reacting lepride, and when removed leave small bleeding points. Sections show exaggeration of the dermal papillæ instead of flattening out as in leprides. The cardinal points are absent.

(*c*) *Morphœa*.—This circumscribed form of scleroderma with its ivory-like centre and bluish-pink margin sometimes suggests a lepride.

The centre is harder when felt between finger and thumb and there are no anæsthesia, etc.

(*d*) *Tinea*.—The various forms of ringworm bear much superficial resemblance to leprosy. *Tinea flava* (or pityriasis versicolor) is exceedingly common in the tropics. Its fine mycelium by refracting light gives a hypopigmented appearance to the skin. This resembles the initial uncharacteristic patch of leprosy which is often so difficult to determine. Close inspection shows, however, that it is superficial as if painted on the skin surface, and a scraping shows up the fungus.

Tinea circinata, though sometimes mistaken for leprosy at first sight, is not difficult to differentiate. There is not the unbroken margin and complete clearing up in the centre found

in the typical lepride There is irritation in place of anæsthesia and fungus in place of *mycobacterium*

Epidermophyton rubrum infection dhobie itch ' may appear like a lepride Its position in the flexor surfaces (axilla or groin) and the irritation it causes make the distinction clear

Onychomycosis generally begins at the distal part of the nail and spreads towards the proximal edge, while the condition caused by leproma begins proximally or simultaneously through the whole nail

Complicating Tinea—Ringworm infection of one kind or another frequently complicates leprosy and grows over areas where leprides had formerly spread and have now resolved These areas being anæsthetic the patient does not feel the irritation and takes no means to stop the infection This tinea complication is often mistaken for a form of leprosy (Fig 23)

(*e*) *Syphilis*—Annular and papular syphilides may resemble the first and fifth forms of leprides but the absence of the cardinal signs and the therapeutic test differentiate clearly

A positive serological test in a tuberculoid case indicates syphilis but uncomplicated leprosy of the lepromatous type will frequently give a falsely positive Wassermann or Kahn For the significance of false positives in the Wassermann and Kahn tests see the work of Hazen *et al* (1936)

(*f*) *Yaws* in its florid state does not resemble leprosy but when it becomes annular there is a likeness except that the edge is rolled and is broken in places The perifollicular papules and follicular keratosis of chronic yaws may be mistaken for the tubercles of leprides (Fig 57, see also p 52) The depigmentation following a diffuse frambœsial eruption is suggestive of early uncharacteristic or lepromatous macules or late tuberculoid scars The thickening and cracking of the skin of the feet in crab yaws may give apparent but not real anæsthesia

The finding of *Treponema pertenue* in early cases the absence of the cardinal signs and the history of yaws—these are sufficient to establish a diagnosis

(*g*) *Tuberculosis*—The term tuberculoid ' suggests resemblance to tuberculosis of the skin Lesions including *lupus vulgaris* may closely resemble leprides The finding of

acid fast bacilli does not differentiate unless material is injected into guinea pigs The absence of anæsthesia and of thickened or tender nerves will generally remove any doubt because in leprides resembling tuberculosis the supplying nerves would usually be affected (Muir 1937 Lowe, 1939)



Fig 57

Chronic yaws lesions of the elbows resembling leprous tubercles (Compare Fig 34) Note the nævus on the buttock

(*h*) *Lupus Erythematosus* may also be mistaken for a reacting or non reacting lepride Here there is irritation rather than anæsthesia and the absence of sensory changes and nerve enlargement or tenderness should make the diagnosis clear

(*i*) *Streptococcal Dermatitis* may resemble leprides but is as a rule not difficult to differentiate in the usual manner

2 Resemblance in Colour Changes

(*a*) *Leishmania* —Indian dermal leishmaniasis is liable in endemic areas to be mistaken for leprosy The writer had frequently two or three such cases a day attending his leprosy clinic in Calcutta for diagnosis The commonest appearance is hypopigmentation and erythema in small ill defined patches with a tendency towards mesial distribution in contrast to leprosy which tends to be lateral affecting the ears before the

nose The absence of cardinal signs in many cases the finding of *L donovani* and the characteristic appearance generally make the diagnosis clear (Dharmendra and Chatterji 1940)

(*b*) *Leucoderma*—In India this is commonly called by a name which means light coloured leprosy, and in spite of its harmlessness often shares the same prejudices as leprosy itself Depigmentation is as a rule complete and not partial as in leprosy, and there is no change in sensation It frequently appears on the site of an old syphilitic yaws or other lesion

(*c*) *Nutritional* pigmentary changes are not uncommon in the tropics The dark colouring of the skin in pellagra and the pale patches especially on the face in vitamin A deficiency are examples

(*d*) *Nævus*—Cutaneous nævus, especially when light coloured on a dark skin, has been mistaken for leprosy The streaked appearance and the absence of sensory changes make the diagnosis clear (Fig 57)

(*e*) *Scars* from old burns and other injuries may be anæsthetic and be suspected as leprosy The history and the absence of thickened or tender nerves, should remove doubt

3 Thickening and Tenderness of Nerves

(*a*) *Septic Neuritis*—Tenderness of nerves and especially of the ulnar nerve just above the elbow is a common cause of leprophobia (p 98) The tenderness may be secondary to a septic focus say in a tooth The patient often a doctor keeps feeling his ulnar nerve and imagines that it is thickened, he thus illustrates the danger of subjective diagnosis Treatment of the septic focus and reassurance of the patient generally clears up the condition and sets the mind at rest

(*b*) *Neurofibroma*—Von Recklinghausen s disease sometimes forms thickenings along the course of a superficial nerve There is however no anæsthesia in the sensory distribution of the nerve such as there would be in leprosy and examination for acid fast bacilli is negative

(*c*) *Hypertrophic Interstitial Neuritis* (Dejerine Sottas Disease) —This disease causes nerve thickening and also polyneuritic signs it is therefore described in the next section

4 SECONDARY NEURAL SIGNS (Lowe and Chatterji 1937)

These are due to central or peripheral injury to or blocking of nerves they cause sensory trophic or motor signs resembling those of leprosy

(a) *Syringomyelia* —Leprosy has frequently been mistaken for this disease and it is important therefore to give the points of differentiation in detail

Sensory changes are asymmetrical and there is loss of both thermal and pain sensation as in leprosy But sensation of light touch is not lost as it would certainly be in any case of leprosy with which it could be confused (dissociated anæsthesia)

Motor and trophic changes similar to those in leprosy occur in the hands and feet but unlike leprosy these changes progress up the limbs and affect other than the intrinsic muscles of the hands or feet

There is no thickening or tenderness of nerves nor are there any sign of skin lesions present or past as there usually would be in leprosy (Schujman 1939)

Wasting of the intrinsic muscles of the hand is present also in *progressive muscular atrophy* but the condition spreads up to the forearm arm shoulder and beyond and there are no sensory changes

Syphilis and tumours of the central nervous system are also capable of causing trophic changes in the hands and feet

(b) *Diphtheria* —Peripheral neuritis following diphtheria may cause glove and stocking anæsthesia of the limbs The history and the absence of nerve thickening make the differential diagnosis easy

(c) *Beriberi* also gives a certain amount of anæsthesia of the limbs which is not difficult to distinguish

(d) *Dermatomyositis* from its skin condition and the fixation of muscles bears a little resemblance to leprosy but there are no sensory changes

(e) *Raynaud s Disease* has often been confused with leprosy because of the loss of digits and later hands and feet In a form of leprosy that could be mistaken for Raynaud s disease there would be complete anæsthesia of the hand or foot whereas in Raynaud s disease there is anæsthesia only of the gangrenous part

(*f*) *Injury or Pressure*—Anæsthesia or atrophy may result from severing or other injury to a nerve, also from pressure on a nerve, such as a branch of the radial nerve being pressed between a watch wristlet and the bone

(*g*) *Cervical Rib* may cause pressure on the lower cord of the cervical plexus resulting in atrophy and paresis of the intrinsic muscles of the hand There may be pain and numbness but sensory changes are slight X ray examination and absence of nerve thickening should clear up the diagnosis

(*h*) *Bernhardt s Syndrome*—Neuritis of the lateral femoral nerve or pressure on the nerve as it passes into the thigh, may cause anæsthesia of the antero lateral region of the thigh The affected area is oblong and varies in its vertical diameter from 2 to 12 in There may be a feeling of gnawing or burning and complete loss of tactile and pain sensation

There are no visible skin changes such as a lepride active or healed would have caused The condition generally heals up with intravenous injections of T A B or other form of protein shock (*Muir and Chatterji, 1936*)

(*i*) *Hypertrophic Interstitial Neuritis* (Dejerine Sottas Disease) —In this uncommon ailment often with a history of heredity there is thickening of nerves with sensory and trophic changes *similar to those in leprosy There is claw hand but in the* lower limb club foot occurs rather than perforating ulcer The nerve thickening is due to hypertrophy of tissue arising from Schwann s sheath which presses on the nerve fibres There may be similar changes in the anterior horn cells and the posterior columns The nerves affected are the ulnar median cutaneous of the forearm saphenous and superficial cervical the thickening may be considerable

In a case of doubt, with no cutaneous signs of leprosy, the finding of acid fast bacilli in a scraping *from a thickened* nerve (p 88) would determine the diagnosis Otherwise the histological examination of a nerve section (p 61) would give a clear indication (Sears 1931)

(*j*) *Other deformities sometimes mistaken for leprosy* are congenital absence of toes , loss of toes following yaws chiggers or ainhum the disfigurements of gangosa

5 Resembling the Lepromatous Type

In differentiating from lepromatous leprosy the diagnosis must depend on finding lepra bacilli

(a) Dermal Leishmaniasis (Fig 58) may closely resemble a typical nodular case of leprosy In an endemic area failure in such a case to find acid fast bacilli calls for examination of a second smear prepared with Leishman s stain Dermal Leishmaniasis would show abundant Leishman Donovan bodies



Fig 58

Dermal leishmaniasis resembling a nodular lepromatous case of leprosy

(b) Diffuse Sebaceous Adenoma may give an appearance of leontiasis similar to that of leprosy and even advanced and inflamed acne has been suspected (Hasselman 1938)

(c) Neurofibroma causes nodulation of the skin which has been mistaken for leprosy but bacteriological examination and sensory changes are negative (Chatterji 1935)

(d) Mycetoma may resemble the advanced or ulcerative stage but it differs from such a case of leprosy in being localised and not widespread over the whole body

(e) Other conditions to be differentiated are mossy foot (*cf* Fig 8) lichen pilaris syphilitic gumma

(f) Eunuchism has been mistaken for leprosy because of the absence of eyebrows and the smooth shiny appearance of the skin

6 Other Acid fast Organisms

The differentiation of tuberculosis of the skin has already been discussed (p 92) The appearance of abundant acid fast

bacilli in the sputum after liquefaction of tracheal nodules has often been mistaken as an indication of pulmonary tuberculosis (p 38) When these two diseases coexist their respective mycobacteria can sometimes be distinguished in a sputum smear *M tuberculosis* being longer thinner and more finely granular and *M lepræ* shorter and thicker with uniform or bipolar staining In cases of doubt, culture or animal inoculation should be used to distinguish the organisms and an X ray examination of the chest should be made

Not infrequently, partly acid fast bacilli taken on swabs from the nose have been mistaken for *M lepræ* For the method of avoiding this mistake see p 84 (Muir, 1937 Lowe 1939)

LEPROPHOBIA

There is little wonder that a disease so much dreaded as leprosy should frequently give rise to this condition

Some of the insidious early signs of leprosy lend themselves to subjective suspicion A pinkish or pale patch on the face noticed daily when shaving in the morning, caused perhaps by seborrhœa, tinea flava or some other common complaint is one of the commonest conditions round which fear crystallises

Another is the ulnar nerve just above the elbow where it is liable to injury and subject to neuritis induced by a carious tooth or other septic focus Constant palpating of the nerve and comparing it with that on the other side tend to confirm *the idea that there is thickening and therefore leprosy*

Yet another site is the antero lateral aspect of the thigh where Bernhardt s syndrome (p 96) not infrequently causes an area of anæsthesia

Anæsthesia of the thumb may be caused by nipping a branch of the radial nerve between a watch wristlet and the bone

Subjects sometimes imagine that the lobules of their ears or their eyebrows are thickened and leprophobia may centre round any well known symptom of leprosy

Neurasthenia often forms the background of this as of other phobias Doctors who have recently begun to treat leprosy and have not yet had time either to overcome their

innate dread of the disease or to become expert in its symptomatology are most liable to suffer It is not unusual for a student after listening to a lecture on leprosy to consult the lecturer on some symptom which has suddenly raised his suspicions

Leprophobia is a most distressing condition Many a sufferer has endured months of mental agony before being reassured as to the baselessness of his fears He should always consult the most experienced and reliable authority otherwise a lurking doubt may remain that the reassurance was not justified In any case when consulted the physician should always take the patient seriously remembering that however flimsy or absurd his symptoms may seem they are probably the focusing point round which unconscious neurasthenic fear have centred Always examine him thoroughly and discuss his doubts with him fully The writer has found that when this is not sufficient it is best to send him back and tell him to get on with his work as a fully occupied mind leaves little leisure for idle fears

CHAPTER FIFTEEN

Typing *and* Recording Cases

THE IMPORTANCE OF TYPING

THE typing of leprosy is no less important than its diagnosis On it depend prognosis public health control and the lines of treatment

Classification has already been discussed in Chapter Six, it remains to give here a simple method of dividing and recording newly diagnosed cases according to that classification

With experience it is generally possible to divide the more typical cases fairly accurately at sight, and those dealing with large numbers of patients and lacking adequate assistance may have to rely on clinical examination for the diagnosis and typing of the majority of cases

With such methods however occasional mistakes are inevitable, and bacteriological examination and the lepromin test should be combined with clinical examination whenever possible

ILLUSTRATIVE CASES

The following six cases illustrate difficulties and the need of great care in classification —

1 A single plaque on the face 2 in in diameter slightly raised and red in colour, a few acid fast bacilli were found at the margin the feather test was negative but the two pin test positive There were two raised annular lesions on the arm The Kahn test was positive The annular lesions disappeared aft r one injection of N A B but the leprous plaque remained *This was a case showing resemblance* to both lepromatous and tuberculoid types The treatment of syphilis might improve general resistance and tip the balance

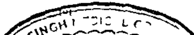
in favour of the latter type Excessive N A B injections might on the other hand temporarily depress resistance and promote the lepromatous type Here the lepromin test is of value in estimating the patient s natural resistance

2 A boy in poor general health came with red swollen ears and face and with annular lesions on trunk and buttocks resembling leprides of the third form (p 57) Numerous bacilli were found in smears from the ears Under suitable treatment the general health was restored and the patient was put on diasone treatment Within four months the face and ears became clinically normal and bacteriologically negative Active signs in the other lesions were arrested The lepromin test at first doubtful became moderately positive Here again was a doubtful case halting between two opinions the improved health and the diasone may have tipped the balance towards the resistant type and recovery

3 Anæsthesia of the ankle and lower part of the leg with tenderness and some thickening of the corresponding superficial peroneal at the knee No skin lesions but a few acid fast bacilli found in the nose the lepromin test was not done A few months later generalised lepromatous signs appeared and later thickening and nodulation of the face Had the lepromin test been done it would probably have been negative and have indicated the coming gravity of the condition which was not at first suspected

4 A patient had a small swelling on his back supposed to be of sebaceous origin but no other signs The tumour was excised and sections showed some perineural cellular infiltra tion This suggested leprosy and sections stained with Ziehl Neelsen showed a few acid fast bacilli A nasal smear also showed a few acid fasts but smears from the ear were negative The lepromin test was negative The patient was at once put on diasone treatment The importance of unusually early diagnosis and typing is shown in this case as very early treatment could be begun

5 A patient was treated for three months at a skin clinic for seborrhœa of the face Thereafter slight anæsthesia of the feet was found and the patient was sent to the leprosy clinic as a doubtful case Clinical examination showed nothing



except the anæsthesia of the feet but a slit smear from the ear showed masses of bacilli, and even scrapings from the surface of the skin in different parts of the body showed bacillary clumps This case shows the importance of bacteriological examination despite the absence of clinical signs denoting an open case Such a patient is of great danger to the public as he can mix freely without his condition being suspected (pp 11 79)

6 This patient had become suddenly acutely ill with fever and an exanthematous rash with swelling covering the most of the body In places the rash was discharging serum and pus Smears from the discharge showed numerous acid fast bacilli Symptomatic treatment and quinine followed by tonics were given Within a few months the lesions had entirely healed, leaving only scars, and bacteriological examination was negative This was a case of acute reacting tuberculoid (lazarine p 62) It resembled the acute reaction in an advanced lepromatous type except that the arrangement of the affected areas was asymmetrical Here the history and the absence of symmetry should have indicated the type and a hopeful prognosis

CASE TAKING

Body charting

The body chart is the most rapid and accurate means of recording details of a case, and should never be omitted whatever other methods are adopted Lesions should be plotted out using symbols to denote the various types and forms (Fig 59)

Areas showing anæsthesia to the feather test are shaded with vertical lines and hypopigmented areas with horizontal lines The position of circumscribed lesions is indicated and the form of lepride (1 to 5) is marked (pp 50 to 57) Lepromatous areas whether diffuse or macular are shaded in with dots and each nodule with an O varying in size with that of the nodule

Ulcers are marked with crosses and deformed digits with

curved lines The position of thickened nerves is shown with lines

Fi 9
Outl n f g e f body l art ng Tub rcul d l s n hown on th ight d nd l p m t on th left

TABULATING PRINCIPAL FINDINGS

Table IV includes the main elements in the classification and the same details as well as those recorded in Tables V and VI can be used in sub classifying (p 30)

TABLE IV

	[illegible]				[illegible]				[illegible]				[illegible]				[illegible]			
[illegible]																				
[illegible]																				

Explanation of Table IV—The three primary types are given in longitudinal columns The first two vertical columns are clinical, giving the degree of affection of skin and mucosa and of nerves and polyneuritic lesions while the last three vertical columns deal respectively with bacteriological examination the lepromin test and reaction Each vertical column is divided into four spaces for negative, +, + + and + + +

In the first column negative means no clinical lesions of skin or mucosa + indicates lesions covering an aggregate of not more than 150 sq cm (25 sq in) + + covering up to one quarter of the body surface, and + + + more than that area

In the second column + indicates thickening and tenderness of one or two mixed nerves without trophic changes in hands feet or face, + + involvement of more than two mixed nerves and/or trophic changes of the face, one hand or foot, + + + more extensive neural or trophic involvement

In the bacteriological column + denotes bacilli present but not more than 10 in any one field and no globi in the whole of any smear (taken from the nose or skin by the method described on pp 84 85), + + one or more globi in the whole of any smear and/or more than 10 bacilli in *any one field + + + more than 10 globi* in the whole of any smear

In the lepromin column – means a negative test, + indicates a flare up to 5 mm diameter in the twenty four to forty eight hours reading or a nodule up to the same diameter in the delayed reading, + + up to 7 mm in either reading but without tissue destruction at the centre in delayed, + + + more than 7 mm in either and/or destruction of tissue at centre in delayed (p 24)

In the reaction column, – indicates no reddening local swelling or thickening of the skin or mucosa and no thickening or tenderness of a nerve, + one or more *erythematous* macules or other lesions without anything of the nature of a flare up and/or nerve thickening or tenderness of minor degree + + lepra reaction of moderate degree in either lepromatous or tuberculoid type, + + + a severe reaction *considerable swelling of lesions* fever and/or liquefaction of

lesions and in tuberculoid cases severe and painful swelling of nerves

DETAILS OF MACULES AND LEPRIDES

In addition to the broad outlines of classification and sub classification in Table IV further elaboration is necessary of circumscribed lesions (macules and leprides) from the clinical details of which considerable knowledge of the case can be gathered These details are summarised in Table V

TABLE V

1 Number – 1 to 10 or 10 +
2 Area index of largest (in square centimetres)
3 Area of central flattening of ditto
4 Type and form of lesion L U 1 to 4 T 1 to 5
5 Marginal serration – to + + +
6 Hypopigmentation – or +
7 Anæsthesia – to + + +
8 Analgesia – or +

Explanation of Table V —This is given under the eight points —

1 The number of circumscribed lesions is marked from zero up to 10 and as 10 + if more than 10

2 Area index This is arrived at by measuring in centimetres (2½ to 1 in) the greatest diameter of the largest circumscribed lesion and multiplying it by the length of the diameter at right angles If no circumscribed lesion mark –

3 Area of central flattening Take the largest discrete lesion and if there is a flattened area in the centre measure it as the area index otherwise mark –

4 Type and form of lesion L = lepromatous macule (p 32), U 1 to 4 = uncharacteristic (initial terminal *undifferentiated or transitional see p 65)*, T 1 to 5 = tuberculoid lepride of Forms 1 to 5 (p 50)

5 Marginal serration Serration of the edge is one of the clearest signs of activity and spread Mark the degree of serration negative, or + to + + + (p 59)

6 Colour change This is due to loss of pigment to be marked − or + Reddening is caused by reaction and is marked in Table IV

7 Anæsthesia to light touch as tested with a feather This can be graded from − to + + + by using three grades of touching instrument (p 81)

8 Analgesia This can be tested by the two pin method (p 81)

Subsidiary Details

There remain a few more points which can be recorded in Table V

TABLE VI

Nodules −, 1 to 10 10+ Size

Ulcers—
 Nodular − 1 to 10 10+ Size
 Trophic − 1 to 10 10+ Size

Nose—
 R − +, + +, + + +
 L − +, + +, + + +

Eye—
 Lepromatous R −, + + + + + +
  L −, +, + +, + + +
 Trophic R − +, + +, + + +
  L − +, + + + + +
 Vision R
  , L

Explanation of Table II—In addition to recording the number of nodules a note should be made of the diameter in centimetres of the largest nodule cutaneous or subcutaneous or of the largest subcutaneous area of induration if such is present

Likewise the longest diameter of the largest ulcer should be noted in addition to the number of ulcers

In the nose condition + indicates infection of the mucosa without nodulation + + nodulation partial blocking but no ulcers + + + ulceration and blocking

In the lepromatous eye + means conjunctival affection with punctate keratitis or keratitis with early pannus and/or pupil irregular but free + + nodulation of the cornea and/or fixed pupil + + + vision destroyed (p 72)

In trophic eye conditions + indicates lagophthalmos + + ulceration of the cornea or scars of former ulceration + + + vision destroyed (p 74)

The visual acuity of each eye should be tested with Snellen s test type and recorded

Sub classification

Besides classification into one or other of the three basal structural types each case should be sub classified in more detail —

(*a*) An uncharacteristic case is again divided into initial terminal undifferentiated or intermediate (p 63)

(*b*) All basic types are divided topographically into cutaneous neural or mixed according as the skin nerves or both are affected (see Table II p 29)

(*c*) Cases are divided bacteriologically into open and closed according as bacilli are found or not by routine methods (p 84)

(*d*) The resistance as shown by the lepromin test forms another basis of division (p 23)

(*e*) Tuberculoid cases may be subdivided according to the form of lepride (p 50)

See also Table III (p 30) giving Pan American Sub classification

SYMBOLS

For convenience, the types and sub types of cases may be denoted by symbolic letters numbers and other signs

Thus Lepromatous = L Uncharacteristic = U, Tuberculoid = T

Each of these three is subdivided according as Skin = S Nerves = N or both = SN, is affected

U is subdivided into initial = 1 terminal = 2, undifferentiated = 3, intermediate = 4

TS is subdivided 1 to 5 according to the form of lepride

LS TS and US are again divided according to the area involved as in Table IV, column 1

LN TN and UN are likewise divided according to nerve involvement as in Table IV, column 2

Bacteriological results are B − to + + + and likewise Lepromin = Lep, and Reaction = R as in the last three columns

Thus TS 1 + N + + B − Lep + + + R + would indicate a tuberculoid case, with skin lesions of less than 25 sq in , leprides with a raised erythematous margin and flat in the centre but without any signs of a flare up, involvement of more than two mixed nerves and/or trophic changes of the face hand or foot bacteriologically negative, the lepromin test very strongly positive

This can be still further expanded using Tables V and VI

GENERAL PARTICULARS

In taking a case, the following general particulars should head the patient s chart age sex home address nationality social status (caste tribe etc), state (married or single etc) general health (complicating diseases, etc), duration of leprosy, first signs history of contracting the disease family history and chances of disseminating the disease

Some of these points are considered in more detail in Part III

CHAPTER SIXTEEN

Prognosis

DREAD OF LEPROSY

LEPROSY is dreaded most of all diseases not because it kills but because it leaves alive not for its pain—though painful at times the loss of pain and tactile sensation is dreaded more Mask face unclosing eyes slavering mouth claw hands and limping feet or even worse beetling brows stuffed nose ulcerating legs and painful eyes drawing on towards blindness—such is the picture conjured up in the mind of the patient when the physician after making his examination pronounces the word—*leprosy* And over and above all this is the thought of the outcast looked at askance by his once familiar friends his name mentioned only in a whisper a shame and disgrace to himself and his family

The patient does not know that leprosy may be mild and abortive a passing condition which heals spontaneously or with a little treatment

Prognosis is important in all serious diseases but in none is it more important than in leprosy And the prognosis must be as accurate as possible built on a sound understanding of all the elements that influence the course of the disease These elements are in order of importance the type of leprosy the extent and progress of disease the general health and presence of complicating conditions the mentality and attitude of the patient the facilities for treatment and attention and later of after care

TYPE OF LEPROSY

The type of disease is the most important factor in prognosis In a frank tuberculoid case with a strongly positive lepromin test the resistance is good and there is a fair prospect of recovery at least in an early case In a frank lepromatous

case however early, the prognosis has always been bad or at best doubtful But the results obtained recently with the sulphone drugs has increased the hope of recovery in this type of case

What the result of sulphones in tuberculoid cases will be we do not yet know The indications at present are that bacilli in close connection with the capillaries—as in the lepromatous and some uncharacteristic cases—are first eliminated In the tuberculoid lesion the bacilli are few and generally shut off from the vascular system

Still the fact that the tuberculoid is generally the resistant case makes it the type most likely to recover There are however, places (pp 32, 66) where tuberculoid cases are stated to degenerate more frequently into the lepromatous type and in these at least without a strongly positive lepromin test a more guarded prognosis would be necessary

Extent and Rate of Advance

In the tuberculoid type early diagnosis and treatment are of great importance, especially if the disease is confined to one or a few small leprides In the writer s experience in North India Africa and the West Indies early cases will clear up as a rule with intradermal injections of chaulmoogra, and the majority will have little or no deformity

The indications are that at least some lepromatous cases (we do not yet know what percentage) heal up on sulphone treatment and that the length of treatment required is in direct ratio to the advance of the disease when treatment is begun We do not yet know what is the minimum period of treatment for an early lepromatous case

In both types the earlier treatment is begun the less is the danger of permanent impairment and deformity of the limbs, face and eyes

Health and Complications

Good general health at the time of first examination of a patient is not necessarily favourable in the prognosis for if his health is depressed by remediable complicating factors, then the removal of these factors may be expected to improve his condition as regards leprosy (p 115) On the other hand

complicating diseases and other unfavourable circumstances which cannot be remedied are bound to have an unfavourable effect on the patient's recovery. As explained in Chapter Five general health though not as strong a deciding factor as natural resistance is of great importance

PATIENT'S MENTALITY AND ATTITUDE

The chance of recovery often depends to a large extent on the attitude of the patient. The treatment may be long and arduous and cannot be carried out satisfactorily without the patient's active and intelligent co-operation. Often he gets tired of treatment, only obeys in part or leaves off too soon. Prognosis should always take account of the patient's mentality and he should be warned how much his chance of recovery rests on himself

FACILITIES

The prognosis necessarily depends to a large extent on the facilities available for the treatment and care of the patient. The average practitioner's ignorance of leprosy and its treatment has often in the past prejudiced the patient's chance of recovery. In most of the endemic countries such as Africa, China and India the facilities for treatment are quite insufficient. Even where treatment is available, care and after-care of the patient are often neglected or impossible from want of friends or adequate staff. Malnutrition frequently counters the best of treatment. All these factors have an important bearing on prognosis

DANGER TO CONTACTS

The main points for consideration are summarised under Risk of Infection on p. 12. The chief determining factors are the closeness and duration of contact, the infectiousness of the case and the age and health of the person exposed to infection. A strongly positive lepromin test is an indication that disease is unlikely to appear or if it does will be of a mild type

The danger from contact is less in leprosy than in tuberculosis as is shown by the former ceasing to be endemic in England centuries ago while the latter still remains

CAUSES OF DEATH

In many cases there is recovery with deformity On p 31 the fourth stage of the lepromatous type is described under Ulceration or Resolution There is a final tendency towards recovery even in the severest case This is brought about by resolution of lesions or by ulceration and shedding of leproma and bacilli During this process however many patients succumb to the ulcerative process and its septic complications or to renal strain following on septic absorption Unless careful precautions are taken tuberculosis is apt to spread through a leprosy institution and may become the principal cause of death

DURATION

There is considerable variation in the duration of leprosy Tuberculoid cases, if treated early, often recover in a few months Otherwise leprides may remain almost stationary for years or gradually spread over the body during a lifetime

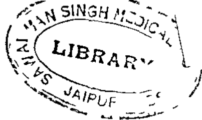
Faget s (1947) report of recovery in advanced lepromatous cases under sulphone treatment (p 124) is summarised in Table VII

TABLE VII

	Years of Treatment					
	Under One	One	Two	Three	Four	Five
Promin (number treated)	8	30	38 (3)	18 (3)	41 (6)	8 (7)
Diasone (number treated)	5	28	37 ( )	4		
Promizole (number treated)	12	7				

The figures in brackets indicate the number discharged as arrested So far there have been no relapses

There is evidence that earlier cases may recover after a considerably shorter period than the above



CHAPTER SEVENTEEN

Treatment

INTRODUCTORY

UP to the last few years leprosy was considered an incurable disease and any treatment given was only in the nature of palliatives The early tuberculoid case with a few limited leprides was almost unknown in Europe and in tropical countries where it is often the commonest form of the disease it was seldom identified The more severe type was rarely recognised till the disease had established itself throughout the system

The acknowledgment that certain cases are amenable to treatment and that at least in the milder type there is a prospect of recovery has profoundly altered the whole outlook and modified the methods of relief and control

Treatment has been divided under *general* and *special* the former including all means taken to improve the resistance of the patient and the latter the administration of special remedies such as chaulmoogra and the synthetic sulphones Lastly there is a chapter on surgical and other auxiliary methods and on the treatment of lepra reaction

RESISTANCE AND GENERAL HEALTH

ROLE OF IMMUNITY AND ALLERGY

It has been shown above that leprosy varies greatly in its gravity from a slight condition that heals spontaneously to a severe disease which in spite of all that can be done progresses steadily from bad to worse (pp 21 22)

We are still very ignorant of the elements which determine this great difference between cases There is no evidence

that it is due to variation in the virulence of *M lepræ* The general health of the patient is of considerable importance, and the course of the disease may be greatly changed by removal of accompanying diseases, correction of diet and improvement of the patient s environment But not infrequently one sees the mildest type of leprosy in ill nourished, unhealthy patients living in the most adverse circumstances, and on the other hand the most severe type appears in robust well developed, athletic people who have led healthy lives under the most favourable conditions This matter has already been referred to on p 22

Antigens and Sera—Many attempts have been made to induce immunity by injection of antigens and sera The antigens include bacilli extracted from leproma and acid fast bacilli mistakenly supposed to be cultures of *M lepræ* Also, animals have been injected with these antigens and their sera used in treatment Claims of valuable results have been made for some of these preparations, but none have so far been substantiated

Nor is this to be wondered at *M lepræ* meets with such tolerance in its host that it can multiply to astronomic numbers without producing recognisable symptoms It would be surprising therefore, if injection of a comparatively small additional number of such organisms could immunise a patient in whom the disease has already been firmly established or if immune serum could be produced in an experimental animal not susceptible to the disease

The Unknown Factor—The difference between the tuberculoid and the lepromatous case is not just one of immunity Nor can it be correct to say that it is one of allergy alone It appears rather that there is an *unknown factor* which in the former type causes the development of timely and effective allergy , while in the latter there is initial anergy followed later by an allergy which arrives too late and is therefore ineffective According to this hypothesis it is the allergic reaction that arrests and limits or exterminates the infection but in order to do this it must arrive in time and in sufficient force before the bacilli have multiplied sufficiently to drown its effectiveness

Unfortunately we are still in ignorance of the factor at the root of this form of resistance It may be that we shall be able to control it once we have other effective means of arresting or delaying the multiplication and spread of bacilli *in the body* (p 128)

RÔLE OF GENERAL HEALTH

Though we cannot induce immunity or as yet control allergy effectively we can do a great deal to improve the general health of the patient This may be discussed under the heads treatment of accompanying diseases improvement of diet physical and mental care and culture

(*a*) *Accompanying Diseases* —In the tropics it is usual to find patients admitted for leprosy to be the subjects of one or more complicating diseases Among the commonest are malaria helminthic infections septic skin teeth etc dysentery and other gastro-intestinal conditions venereal diseases In many cases it may be counted an advantage if the patient is found suffering severely from *remediable* accompanying diseases as their removal may be followed by improvement in his general health and consequently *in the leprotic condition*

The writer has found the *red cell sedimentation test* (p 123) of considerable value in tracing and eliminating such diseases as their presence accelerates and their elimination retards the sedimentation rate It must be remembered however that lepra reaction (Chapter Eight) also causes acceleration

(*b*) *Diet* —As in tuberculosis this is of considerable importance Well cooked and appetising food on a well balanced scale is necessary but over eating and indulgence must be guarded against The athlete should be taken as the patient s ideal He should as far as possible get into and keep himself in training At least the lepromatous case hoping for recovery should limit his alcohol and tobacco as does the athlete In the milder types also this is advisable though not so necessary

(*c*) *Physical and Mental Care* —Once the complications and diet have been attended to a foundation has been laid for the patient s activities These may be included to a large

extent under the term occupational therapy Work must be interesting and suited to his capacity It should be in the open air and so planned as to develop his muscles without imposing undue strain Cheerfulness the creative sense and a feeling of usefulness to the community—all these have a *physically stimulating effect of great value in the treatment*

The admission of the patient to a well run institution should remove the feeling of shame and ostracism which has such a depressing effect Care should be taken that he does not leave behind him dependents over whose welfare he is constantly worrying Thus connected with all leprosy institutions there should be a welfare service planned to relieve patients of anxiety as far as possible (see Chapter Twenty seven)

Well adapted physical exercises games, etc have also a special use in preventing deformities especially of the hands Particular care must be taken in fitting boots and shoes to guard the feet from injury bearing in mind the loss of protection due to anæsthesia wasting of the supporting intrinsic muscles and softening of the bones

In leprosy institutions arrangements for education culture and recreation are important factors in the patient's life and in his chance of recovery

Chapter Eighteen

Hydnocarpus Oil

General treatment may be taken as the foundation of special treatment, particularly in the lepromatous type. Whatever the form of special treatment, it is likely to be prolonged and to be a strain on the general health. Accordingly, the higher the standard of general health maintained, the more vigorously can special remedies be pressed and the more likely are they to be effective.

Until recently, the almost universal remedy was chaulmoogra (more correctly called hydnocarpus) oil and its derivatives. This is administered by injection into the skin, subcutaneous tissue or larger muscles. Intradermal injection of hydnocarpus is still the treatment of choice in tuberculoid lesions, but in the lepromatous type it is gradually being replaced by the sulphones (Chapter Nineteen), which may also prove to be the better remedy in many cases of the uncharacteristic type with a negative lepromin test.

Preparation

Hydnocarpus oil is obtained from one or other of two species: *Hydnocarpus wightiana* in South-west India and *Hyndnocarpus anthelmintica* in Thailand (Siam) and Indo-China. The oil was formerly given by the mouth, but this method has now been almost entirely abandoned in favour of injection.

The best oil is prepared by cold extraction from fresh fully ripe seeds. Both seeds and oil are apt to undergo oxidation and develop irritant qualities if kept too long. It is most satisfactory to obtain oil direct from South-west India.*

* Th[illegible] Ern[illegible]k[illegible]lum Trad[illegible]ng C[illegible] [illegible] E[illegible]n[illegible]kul[illegible]m S[illegible]th[illegible]w[illegible]t Ind[illegible] [illegible]ppl[illegible] a pu[illegible] f[illegible]m l[illegible]cally gr[illegible]w[illegible] [illegible]eed

Some prefer the ethyl esters of the oil and this has the advantage of being thinner and less viscous, passing more easily through the needle (*for preparation see Appendix I*) *The oil can* however be made thinner by heating immediately before injection up to about 120° F and it can be stored longer *than the esters without becoming irritant Both forms give* approximately equal results

Storing and Sterilising

Contact with air or moisture shaking exposure to light or heat—all these tend to promote oxidation and the formation of irritant substances The oil (or esters) should therefore be stored in clean, dry bottles These should be of such a size that once opened the contents will be used on one occasion or at least within seven days To diminish contact with air bottles should be filled to the neck or as high as possible allowing for expansion during sterilisation

Oil must be sterilised by heat (unless this has already been done by the suppliers) and the bottles used should therefore be of a quality which will stand high temperatures

It is well before heating to place the cork loosely in the mouth of the bottle and tie over the cork and round the neck a few layers of sterile gauze With a high pressure steriliser keep the temperature at 120° C for half an hour Open the steriliser lid before the pressure becomes negative otherwise moisture is apt to be drawn into the bottle and make the oil cloudy and irritant

The alternative is to use an oil bath Submerge the bottles almost to the level of their contents in an *open* vessel containing any waste oil available Heat the outside oil to *125° C and keep it at this temperature* for forty five minutes

After sterilisation immediately press home the cork but retain the gauze over the cork and mouth of the bottle so as *to keep them sterile Stored in a cool* dark place fresh oil should remain suitable for injection for at least six to twelve months

Those using *large quantities of hydnocarpus* oil are advised to buy it direct from the manufacturers (see footnote p 117)



Fig 60
H d a pus a tf In t ca tree



Fig 61
Fruit and lea es of *Hyd oc pus th lm t*

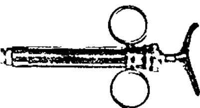


Fig t
: w th h t sc w-on edl f nt d rm l ject



F 63
Sk n wh h h t been jected ntr d rm lly Tl wh l sed ha n ged to u for l ra sed and th k ned re w th p m t k m k gt

in tins of not more than half a gallon capacity Oil which has been imported in large drums, or has been stored by dealers for long periods, is almost always highly irritant and unsuitable for injection Treating this oil later with a view to removing those irritant qualities is not as a rule very satisfactory

Mode of Action

We do not know how hydnocarpus oil acts Given intra dermally into and round tuberculoid lesions the effect is mechanical, at least in part the injected oil causes slight local irritation and tissue reaction and these result in the destruction of bacilli in the immediate neighbourhood

Degotte (1944) has claimed equally good results with a mixture containing one part of oil of citronella (*Cymbopogon nardus*) and nine parts of cotton oil

It has never been found possible to carry out a fully con trolled trial with hydnocarpus oil Some workers have found it of great value while others have questioned its effectiveness The difference in results is probably dependent in part on variations in the severity of leprosy from one country to another

Injections in Circumscribed Lesions

The treatment of lesions limited by definite spreading margins—such as leprides and some uncharacteristic macules —should aim at arresting their further enlargement This is generally practicable if the lesions are few in number and not too extensive The principle is the same as that of arresting a forest fire by clearing or burning a gap in the forest across which the advancing flames cannot leap Hydnocarpus oil or ester is injected intradermally into or just beyond the advancing border of a lesion through a series of small punctures The drug is absorbed by the protective cellular elements which it stimulates to activity with resulting phago cytosis and destruction of the infection It should be remembered, however that the line of bacilli is often in advance of the clinically visible margin

Injections are made at or slightly beyond the margin

Holding the syringe at an acute angle with the surface the needle is inserted into but not through the skin Sufficient is injected at each puncture to raise a wheal about 1 cm (⅜ in) in diameter One or more lesions according to the size are surrounded with a line of such wheal each touching the next and up to 50 or 60 in number (see Figs 62 63)

Injections are repeated once or twice a week till all lesions have been encircled

If the centre of the lepride is flattened out only the raised margin requires infiltration but if the whole area of the lepride is uniformly raised and thickened infiltration should be extended to the centre also

It is well to begin by injecting not more than 1 or 2 c c at one sitting once a week but according to the tolerance of the patient the amount can be gradually raised to 5 or 6 c c once or twice a week

No one area should be reinfiltrated till after a month or at least till all irritation and induration caused by the former injections have entirely disappeared Five or six courses of injections or even more may be necessary before all active signs disappear though some lesions clear up with two or three courses

The effect of intradermal injection of hydnocarpus may be considerably enhanced by painting the injected areas a few days later with a 1 in 3 solution of trichloracetic acid in distilled water *First remove all grease from the skin with a fat solvent* Then paint on with a brush (or cotton wool wrapped round a probe or thin stick) and dry by fanning If on drying the skin is not slightly white then repeat the paint When whitening appears paint the area with a bland oil It has been found a good plan to paint at each sitting the skin area injected on the previous occasion

In Brazil Dr Araujo has substituted for intradermal injection fulguration with a galvanocautery he makes multiple skin punctures varying in depth with the thickness of the lesion This appears to give at least equally good results suggesting that the effect of hydnocarpus when given by this method is largely the mechanical one of stimulating the local cells to phagocytose the bacilli

Lepromatous Cases

This also includes uncharacteristic and other cases which are still active but have no circumscribing margin

Until recently almost the only special treatment of these types was by *injections of hydnocarpus oil or esters* These may be given intradermally infiltrating by the method described above a limited square or rectangular area of 4 to 8 sq in (25 to 50 sq cm) at each sitting This is continued systematically till all the affected skin has been covered after which the same process is again and again repeated The skin is likewise painted with trichloracetic acid

An *alternative method is to inject hydnocarpus intra* muscularly in the gluteal or deltoid regions The dose should be divided not more than 1 or 2 c c being injected at any one spot By partly withdrawing the needle and reinserting it at a different angle the whole may be given through only one skin puncture

Similarly injections may be given subcutaneously in an extensor area such as the lateral aspect of the thigh

By one of these methods or using a combination of more than one 5 to 10 c c may be injected twice a week It is well however to begin with a small dose (1 or 2 c c) once a week and gradually raise the amount *according to the tolerance of the patient In the first* and second age groups (p 16) the dose should seldom exceed 2 and 4 c c respectively

Here also painting with trichloracetic acid as mentioned above is a useful auxiliarly to hydnocarpus treatment

There is sometimes an advantage in *breaking up hydno*carpus treatment into courses of two or three months with an interval for recuperation between courses or injections may be stopped or reduced during the most trying time of the year (as the hot weather in India)

The most suitable dosage is an individual matter The physician should always be on the alert for signs of reaction *or of weakness and debility*, and be ready at once to cut down or suspend treatment

A valuable aid in the regulation of treatment is the rate of

red cell sedimentation This can be ascertained quickly and with sufficient accuracy by using the microsedimometer *

If this test is done every week or fortnight accelerated rate gives a warning of danger from excessive treatment just as it also warns of the presence of complicating diseases (p 115)

Duration of Treatment

This varies widely with the type of case and the rapidity with which the patient recovers up to the point when all active signs disappear Smears from a bacteriologically positive case who has reached a stage at which the bacilli are few should be examined every three months till they become negative and then every month for six to twelve months Thereafter *if all clinical signs of activity are gone hydnocarpus treatment* may be stopped but the patient should be re examined at least every six months for from one to seven years the length of time depending on the previous seriousness of the case and its stubbornness to treatment

In tuberculoid and other cases with negative smears from the beginning one must await the disappearance of clinical signs (p 58) after which treatment may be stopped but an equally careful routine of inspection is advised always remembering that some of the less well defined negative cases may become apparently inactive and then appear later as positive

Active Signs Arrest

Active signs are positive bacterial findings raised inflamed or indurated skin lesions increase or decrease in size or number of lesions thic [illegible] tender [illegible]s When these have definitely gone th [illegible] id [illegible] iescent and when under check of [illegible] ntinued quiescent for two years it [illegible] es [illegible] 8

Med by [illegible]

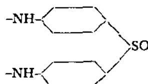
CHAPTER NINETEEN

Sulphone Treatment

WHILE the treatment of choice in the frank tuberculoid case is still hydnocarpus oil and its derivatives the effectiveness of this drug in the lepromatous type has not been without question There is reason to believe that a more satisfactory remedy has now been found in the sulphones

NATURE OF SULPHONES

These synthetic drugs are derivatives of diaminodiphenyl sulphone



It was their antibiotic effect in controlling the growth of *M tuberculosis* in experimental animals and *in vitro* (Feldman *et al* 1942, Petter and Prenzlau 1944) that first suggested trial in leprosy They however have shown much more evidence of usefulness in leprosy than in tuberculosis

The sulphone derivatives which have so far been tried in leprosy are ' promin (U S A promin ' in England promanide) (diaminodiphenyl sulphone *nn* didextrose sulphonate), diasone (di odiumformaldehyde sulphoxylate of diaminodiphenyl sulphone) promizol (*^* 4 -*diamino* *ↄ* thiasolylphenyl sulphone) and sulphetrone (tetrasodium 4 4 bis [α phenylpropylamino] diphenylsulphone *a a a a* tetrasulphonate) Promin (P D & Co) was first used in the National Leprosarium Carville U S A (Faget *et al* 1943) It

was found to be excessively toxic by oral administration but to be tolerated intravenously in daily doses up to 5 gm Following on the first published results on promin the writer (Muir 1944) began a trial of diasone (Abbotts) in Trinidad Fearing that diasone might be toxic by mouth like promin he first gave it intravenously but later found that it was well tolerated orally in daily doses up to 2 gm A more recent sulphone derivative promizol (P D & Co) is considered by the Carville workers (Faget Pogge and Johansen 1946) to give possibly even better results than the first two preparations though it has not yet been tried out sufficiently This can be given orally in daily doses up to 6 gm Lastly sulphetrone (B W & Co) is under trial and the first reports indicate promising results after initial smaller doses 3 gm taken six days a week and three weeks a month is tolerated

The results obtained with these sulphones appear to be similar though they vary in the degree of toxicity the amount of the effective dose and the speed of results

MODE OF ADMINISTRATION

Suitable Type of Case—It is the lepromatous or severe type of leprosy to which sulphone treatment has been applied that is to say the type which so far has been less amenable to treatment by chaulmoogra and other drugs It is still too soon to say what their effect will be in tuberculoid and uncharacteristic cases

Toxic Effects—Faget *et al* (1943) mention the following toxic signs as occurring decrease in blood cells leucopenia allergic dermatitis allergic rhinitis mild and ephemeral headaches and nausea and lepra reaction including iridocyclitis Further observation has however shown that with suitable dosage most of these can be avoided

An important question is whether or not it is necessary to control treatment by blood concentration tests If this were necessary the usefulness of the sulphones would be limited by the inadequacy of skilled staff especially in highly endemic countries where this treatment is most necessary In the initial working out of dosage such tests are advisable but thereafter in the writer's opinion the few simple rules

given below (blood examination clinical observation, regulation of dosage) are sufficient in the hands of a competent clinician

Anæmia (partly due to interference with iron absorption) and increased reactionary exacerbations are the two toxic indications to be guarded against and these are apt to occur principally in patients in poor general health and/or in an advanced stage of the lepromatous type, and at the beginning of treatment The patient should first be examined for anæmia, and when this is present, as it often is in severe lepromatous cases, a preliminary course of full doses of ferrous sulphate or carbonate should be given before starting the sulphones

Dosage—The writer's experience has been chiefly with diasone (Muir, 1944, 1946), and the dosage here described is what is recommended in the use of this drug Considerably higher doses have been used with promin and promizol (Faget *et al*, 1943 1946) It is advisable to begin with small doses in all cases and gradually raise the amount according to the tolerance of the patient In doing this the important indications are the stage of the disease the general condition of the patient, especially as regards febrile and focal reactionary signs, the condition of the blood as regards the presence of anæmia If the hæmoglobin percentage is below 70 a preliminary course of iron should be given and if this is not effective injections of liver extract should be added

Diasone is generally made up in 5 gr (0 3" gm) capsules or tablets When the hæmoglobin is at or over 70 per cent begin with 1 2 or 3 tablets according to the general condition of the patient This should be taken in one undivided dose, preferably an hour after food so as to promote quick absorption and the highest blood concentration Reactionary signs are not a contraindication to beginning the treatment but are a *warning not to raise the dose too rapidly* Whatever the initial dose repeat it every second day for the first week unless there are signs of exacerbation In robust early cases without septic or other complications 1 tablet may be added after the first week on the intermediate days and increased gradually

till after three or four weeks the patient is taking 3 tablets daily for six days a week It may however be a considerable time before a weaker or more advanced case reaches this dosage The hæmoglobin should be tested every week to begin with and iron (and if necessary liver extract) continued in all cases with a percentage below 80 or 90 A fall below 70 per cent or the intercurrence of increased reaction calls for temporary suspension of diasone or diminution of the dose When a dose of 3 tablets a day for six days a week has been reached it is well to suspend treatment for one week every month so as to give the patient time to recuperate In patients who have improved and are free from signs of anæmia and reaction the dose may be gradually raised to 6 tablets daily six days a week for three weeks a month—this being regarded as the maximum average dose though it may be increased or diminished according to the body weight of the patient

Effects of Treatment

These vary according to the stage of the disease In an advanced lepromatous case with grave complications—ulcerating leproma of the limbs ulceration of the nasal and other mucous membranes with obstruction of breathing and severely affected eyes going on to blindness—the first effects are the healing of ulcers clearing of the nose and arrest of the eye condition with improved vision These often take place within a few weeks

The next effect is seen in patients with chronic or subacute allergic reactions indicated by slight rise of temperature and or the frequent appearance and subsidence of nodules and other inflammatory skin lesions these symptoms gradually subside though in some cases they are increased during the first few weeks or months At the same time permanent nodules and other raised skin elevations become slowly absorbed and flattened out leaving marked wrinkling of the integument This improvement generally requires a few months

The third stage in recovery and the only one in early or less advanced cases is the gradual lessening of the number of bacilli found in sections and smears from the skin and in smears from the nose Thus + + + cases become + +

and then + and + cases become negative The time required for this appears to vary with the advancement of the disease, some early cases have become negative in four to six months, but more advanced cases may require four five or even more years (p 112) One of the most striking signs of improvement is that seen in the affected eye and especially in the cornea, where because of its transparency the arrest and a certain amount of recession of the lepromatous infiltration can be observed with a lens or a corneal microscope (p 74)

In the writer s experience every case that has been under treatment for six to twelve months has at least shown definite and in some striking improvement Patients who for years have been slowly worsening under hydnocarpus and other treatment begin to make steady, though it may be slow, improvement

Sulphetrone —There are indications that this sulphone de rivative is less toxic and more quickly effective than those first used A rather higher dose than that of diasone is tolerated 3 gm a day being a safe amount after preliminary lower dosage has been worked through, and some recommend even 4 or 5 gm As with diasone the one day rest a week and one week rest a month are advised

There is one important point on which sufficient reports are not yet available, that is whether or not a point is reached at which the type changes—the lepromatous case is trans formed into a tuberculoid one and a negative lepromin test becomes positive Theoretically the lepromin test is negative in the lepromatous case because the antigen (*i e* lepra bacilli) are in such great excess of antibodies formed that an effective allergic reaction which would destroy the bacilli, cannot take place As the bacillary antigen becomes less and less is a point reached at which an effective reaction can take place? If so it would be indicated by a positive lepromin reaction, and we should have an additional factor helping to clear up the residual bacilli I have found indications in one or two cases that this may occur to some extent and other workers have reported similar results but further evidence is needed

Length of Treatment

In any case treatment should be continued at least until repeated bacterioscopic examinations have given negative results over a period of six months to two years varying *directly with the advance of the disease at the beginning of* treatment and with the length of treatment required to produce the first negative bacterioscopic results (Note *Faget's figures on p 112*) For arrest of disease see p 123

Iodides have a specific effect in showing up concealed lepromatous foci It is possible that their careful administration in cases that have become bacterioscopically negative may be *of use in determining the length of further treatment required* and perhaps in speeding up the elimination of residual foci but this matter still calls for very careful investigation

Regulation of Established Treatment—Particulars have been given of the dangers attending the initial treatment with diasone But once the patient has taken his maximum dose *for a few months* without diminution of hæmoglobin content or reactionary *symptoms* and has made definite improvement as regards both leprosy and his general health such strict precautions cease to be necessary and treatment may be *continued by an intelligent and reliable patient with a minimum* of supervision A visit to the doctor once a month is often all that is needed This fact is particularly helpful to patients *under domiciliary treatment though in some countries there* are grave risks to be guarded against from unreliable patients misusing such a privilege

Mode of Action

It is still uncertain how the sulphones act Fite and Gemar (1946) after an examination of biopsy *sections from 32 patients* under promin concluded that tissue changes are atrophic in character with extremely slow and gradual lessening of numbers of organisms in the lesions to the point of final disappearance in 10 of 3[illegible] cases examined The important *finding is* that promin appears to eliminate bacillary infection of the blood vessels and blood stream thereby preventing the *formation of new lesions* The atrophy of focal lesions is also more apparent in [illegible] with a more generous blood supply

The rapidity with which eye lesions respond (as shown by the corneal microscope), and those of the nose heal and in some cases become bacteriologically negative suggests that sulphones concentrate in the eyes and the nose Examination of the skin and mucous membranes and their secretions should indicate the local concentration of the drug and the period of local retention Such indications may throw further light on the minimum dosage required to keep up an effective local concentration

The results of treatment indicate strongly that the best effects may be expected in cases whose treatment is begun at a comparatively early stage of the disease

We do not know whether sulphones actually destroy lepra bacilli or only prevent their multiplication Nor do we know whether the acid fast bacilli found in patients for years after sulphone treatment has been begun are alive or dead for lepra bacilli killed by heat and injected into rats can still be found acid fast after eighteen months These are important matters which may take some time to clear up

Final Results

It will require years before we can say with any confidence what the final results are—in how many cases a complete and lasting cure is possible what is the relapse rate and whether relapsed cases will yield to further courses of treatment

Confidence is given however by the fact that experienced workers all over the world who have carried out the initial trials have almost without exception obtained favourable results such as they had never before found with other remedies Many have reported definite improvement in practically all ca es that have been under treatment for at least six months

There are so far no indications of patients becoming sulphone resistant

The history of a rising scale of effectiveness in other drugs such as the sulphonamides gives reason for hope that sulphone derivatives may be produced which will give even more rapid and effective results The radicle diaminodiphenyl sulphone which is common to all the above derivatives is also in course of trial

CHAPTER TWENTY

Surgical *and* Auxiliary Treatment

EXCISION OF SKIN LESIONS

EXCISION of one or more small definitely limited tuberculoid skin lesions may eradicate the disease but equally good results can generally be more easily obtained by intradermal injections of hydnocarpus oil (p 120)

In lepromatous cases æsthetic as well as ameliorative improvement can be gained by shaving off nodules and the outer layers of thickened skin and by trimming enlarged and nodular ears Before excision a clamp should if possible be applied so as to render the area bloodless A caustic such as pure carbolic acid is painted on the raw surface before removing the clamp When the face and ears are the sites bleeding can generally be stopped without bandaging by applying shreds of cotton which promote clotting and harden into firm crusts The need for such operations is becoming less as nodules tend to shrink and disappear under sulphone treatment

CAUSTICS AND OTHER APPLICATIONS

Reference has been made on pp 121 122 to the application of trichloracetic acid solution to tuberculoid and lepromatous lesions also to fulguration of the skin with a galvanocautery multiple punctures being made in the skin to a depth varying with the thickness of the lesion Carbon dioxide snow pencils have been found useful in promoting absorption of nodules Pressure is applied with the end of the pencil for half to one minute

Hot baths and friction of the skin with a bland or slightly stimulating oil are useful in promoting the circulation and assisting the absorption of leproma as well as in softening and

protecting the epidermis, which is liable to become dry, cracked and abraded For massage and electrical treatment see p 139

Nerve Operations

Splitting, or removal of a thickened nerve capsule or division of hard connective tissue binding down the ulnar behind the elbow or the superficial peroneal at the neck of the fibula may relieve pain and sometimes restore function This is chiefly called for *in reacting tuberculoid cases (pp* 59 62)

Abscesses of nerves subcutaneous tissue or tendon sheaths *occurring in tuberculoid cases may have to be incised They* contain pus or white liquefied caseous material and generally acid fast bacilli though not in large numbers The abscess *cavity should be scraped out and the wound sutured leaving* a fine gauze drain Stretching of leprous nerves is dangerous and not beneficial

Lepromatous and Trophic Ulcers

In severe lepromatous cases interference with the circulation of the skin and pressure on the epidermis are apt to cause ulceration especially in lepra reaction Such ulcers may become very chronic and hard to heal and the more so when complicated by septic infection

One of the best local applications is 1 in 3 sulphonamide paste containing cod liver oil

If local remedies fail, penicillin treatment may cause healing But as a rule sulphone treatment is the most rapidly effective

In contrast to the lepromatous ulcer is the trophic ulcer found in polyneuritic lesions of the hands and feet and due partly to injury and partly to interference with trophic supply to the extremities Patients should be told of the danger arising from anæsthesia and warned to protect their fingers especially from fire and hot surfaces

Trophic (perforating) ulcer of the foot is among the commonest complications For protection care should be taken to choose soft and well fitting shoes To enable the trophic ulcer to heal pressure should be removed either by suitable local padding or by use of crutches If it becomes inflamed

or if the bone is involved operation may be necessary Chronic trophic ulcers may be stimulated to heal by injecting into the surrounding tissues hydnocarpus oil or esters or a weak solution of Dettol sufficient should be injected to cause a mild local inflammation

Mom and Bernal (1946) claim more rapid clearing up and cicatrisation with a freshly prepared 2 per cent *tyrothricin* in alcohol *This is a mixture of two polypeptides—gramicidin* from *B brevis* which is bactericidal for gram positive micro organisms only and tyrocidin which is active against both gram positive and gram negative but can only be used locally because of its toxic qualities to the blood and the kidneys

BONE OPERATIONS

Loss of sensation atrophy of the small muscles of the sole and consequent injury often cause ulcers of the sole which



Fig 64

Figs 64 [illegible] with [illegible] left [illegible] operation [illegible] removal of the third metatarsal [illegible] through a dorsal [illegible] through a plantar [illegible] latter [illegible] the wound [illegible] of the former perforating ulcer [illegible]



Fig 65

develop secondary infection and in the end cause necrosis of phalangeal metatarsal and sometimes tarsal bones When superficial these trophic or perforating ulcers will often heal with ordinary dressings provided the affected part is

kept off the ground by padding the sole or using crutches Dead or decalcified bone should be removed without delay otherwise septic absorption and immobilisation of the patient have deleterious effects

Surgical interference for the removal of dead bone from the fingers is often necessary Great care should be taken to conserve the function of the fingers as much as possible

Partial or total metatarsectomy can be done through an incision on the dorsal or plantar surface Anæsthesia of the foot generally makes an anæsthetic unnecessary After removing the bone and trimming the soft tissues bleeding is controlled by packing the wound tight with sulphonamide gauze and applying a few temporary stitches which are removed after forty eight hours After healing, the wound should be allowed to consolidate for a few weeks before the foot is put to the ground

Where the distal tarsi are diseased, *Syme s amputation* will often give good results

NOSE OPERATIONS

Nodulation ulceration and scar contraction resulting in obstruction of the nose often give great distress If dilatation with bougies cauterisation and other milder forms of treatment do not suffice, the obstruction must be removed by paring away the lepromatous lining including the affected turbinate bones A rubber tube is worn for one or two months till healing takes place

Infected lacrimal sac is not uncommon in leprosy If it does not yield to penicillin or other remedies it should be excised

As mentioned above nose conditions tend to clear up rapidly under sulphone treatment (p 127)

When active disease has ceased nasal deformities may be improved by a plastic operation an ivory plate should be inserted

The application with a brush inside the nose of a 1 in 10 solution of trichloracetic acid will sometimes hasten the clearing up of infection especially when used in combination with sulphone treatment

THE EYE

In the more severe forms of leprosy vision may be improved and blindness averted by timely action The pupil should be dilated with atropine or if this is not tolerated with homatropine before posterior synechiæ form and the pupil becomes fixed Increased intra ocular pressure may be prevented by iridectomy and this operation may be more safely done if the tendency to reaction has been controlled by a previous course of sulphone

Acute lepra reaction in the eye can be relieved immediately by injecting a 1 in 1 000 solution of trypan blue in saline so as to balloon up the bulbar conjunctiva cocaine having been first instilled (Muir and Chatterji 1930) This condition however yield as a rule within a few days to sulphone treatment (p 128)

In view of the possibility of septic complication it is well to apply penicillin ointment for a few days in all acute inflammations of the front of the eye

In *lagophthalmos* a sequela of the tuberculoid type (p 74) the eye should be protected by instilling liquid paraffin drops by day and bandaging on wool soaked in liquid paraffin at night In some cases the eye may be protected by lateral tarsorrhaphy care being taken not to occlude the line of vision (Gass 1934)

LEPRA REACTIO

This condition has already been described (pp 45 6) In its severer forms it is one of the most distressing complications of leprosy and calls for careful and skilled treatment

Like other febrile states it requires rest in bed Laxatives are particularly necessary considering that diaphoresis is impeded in many cases by the anidrotic condition of extensive areas of the skin Large doses of alkalis are indicated (sod bicarb 60 gr four times a day) and calcium lactate should be given (o gr thrice daily)

Lepra reaction is often incited by some weakening intercurrent disease apart from leprosy among which chronic dysentery malaria helminthic infections septic conditions venereal diseases are the commonest These should be sought for and dealt with if present

If no such inciting cause is found, and if under general treatment the fever and other symptoms do not begin to subside in a few days, then other remedies must be tried. Of these sodium or potassium antimony tartrate in small doses given carefully into the vein is the most effective (2 to 4 cg in 2 c c of normal saline every second day). If the condition does not yield to this within two weeks, try intravenous mercurochrome (2 c c rising to 6 c c of a 1 per cent solution every second day) or fluorescein (in similar doses). None of these remedies should be persisted with too long or given in larger doses as excess tends to increase rather than diminish reaction.

Pogge and Ross (1946) mention favourable results with injections of insulin in *erythema nodosum*, that is recurring evanescent nodules of the skin which are often accompanied by painful neuritis. They found that in this condition there was frequently hyperglycæmia and 25 to 40 units of protamin zinc insulin daily gave relief. This is in line with the old practice well known in India of dieting reacting cases on lentils thus reducing the blood sugar.

Wharton (1947) has recently reported remarkably favourable results with *benadryl* (beta dimethyl amino ethyl benzhydryl ether hydrochloride). This is given orally in 50 mg doses thrice daily. Acute reaction and painful neuritis where other remedies had failed were relieved in twenty four to forty eight hours. The writer attributes this to its anti histamine action on the supposition that the symptoms of lepra reaction are dependent on histamine being set free in the blood (p 48).

One of the effects of sulphones has been mentioned as gradually diminishing and then removing a tendency to reaction though when given in excessive doses they tend to stimulate reaction. Small doses should therefore be given tentatively if the patient is not too anæmic.

Care should be taken that patients are not confined to their beds too long by lepra reaction, they should be encouraged to take regulated exercise as soon as the acute exacerbation has abated.

Subacute reaction may continue with a low febrile rise for lengthy periods (Fig 22). This may be complicated by

septic infection of large lepromatous ulcers Sulphone treatment is particularly useful in causing these to heal (see pp 35 46 127)

In tuberculoid cases acute reaction may call for surgical interference A large mixed nerve may by severe inflammatory swelling become nipped either in its own thickened sheath or by being bound down to bone by unyielding fibrous tissue the commonest sites are the ulnar at or above the elbow or the superficial peroneal at the neck of the fibula Unless the pressure is relieved without delay it may cause serious permanent damage to the parts supplied The thickened capsule should be divided longitudinally or the constricting fibrous tissue incised This will often result in immediate relief of anæsthesia and other symptoms in the hand or foot (p 69)

The treatment of reaction in the eye is dealt with under complications of that organ (p 135)

PAIN AND ITS TREATMENT

In the majority of cases leprosy is painless in its onset and may persist for years without causing any severe distress At times however the patient is racked with acute pain or tortured with aching discomfort and it is important to understand as far as possible the causes and the remedies

The commonest forms of pain in leprosy are neuritis in the larger nerves hyperæsthesia of the affected skin and pain and discomfort in the bones and in the eyes and nose

1 *Neuritis* It is to be expected that a disease which attacks the peripheral nervous system should at least at times cause considerable pain in the nerves The wonder is that there can be severe infection of the nerves as in lepromatous cases without any noticeable neural symptoms

In the tuberculoid type the case is different and one of the chief clinical characteristics is thickening and *tenderness* of superficial nerves It is however during exacerbations (lepra reaction) in tuberculoid cases that distress may be severe Previous to the reaction the sheath (epineurium) and sometimes other fibrous tissue of the nerve have become thickened and inelastic and accordingly when sudden acute congestion occurs there is severe pressure on the sensitive axis cylinder

The patient should be treated for lepra reaction as described above but if this does not rapidly remove the pain then special remedies must be used

Sometimes the congestion and pain can be relieved by infiltrating into the soft tissues round the swollen nerve 10 c c of a sterile 0 5 per cent solution of *sodium bicarbonate* in distilled water with 0 5 c c of *adrenaline hydrochloride* solution or 0 02 gr of *ephedrine sulphate* added just before injecting

If this fails the injection of 0 25 to 0 5 c c of 75 per cent *alcohol* under the sheath of the inflamed nerve will generally give rapid relief Alexander (1934) recommends infiltration round the painful nerve of a 25 per cent solution of magnesium sulphate in water which he claims gives more lasting relief than alcohol

Gass (1938) states that the use of *cobra venom*—injections on alternate days in one rising to ten mouse unit doses—gave marked improvement in 75 per cent of cases and in only one was there no improvement

Splitting of the nerve sheath (p 132) will give relief and conserve function in the most severe cases

In the less acute or when the acute stage has subsided, *diathermy* is of distinct value

Badger and Patrick (1938) found that intramuscular injection daily of 300 units of B_1 *concentrate* and the same dose twice daily by mouth, gave spectacular results in treatment of acute neuritis in leprosy

Recourse has sometimes to be had to *analgesics* like opium preparations or phenobarbitone but they should be used as little as possible remembering that they tend to depress still further a patient whose condition is already hampered by depressed health

2 *Hyperæsthesia of Affected Skin* —This is most noticeable in the soles of the feet and is indicative of acute or subacute lepra reaction in lepromatous cases

Ryrie (1938) found that by firm stroking or pressure on the plantar surface he could determine by the pain reaction mild degrees of lepra reaction before other signs had appeared

Great discomfort is present during lepra reaction in inflamed and hyperæsthetic lesions all over the body This

is increased when there are ulceration and septic complications such as frequently occur in advanced lepromatous cases

Treatment consists in dealing with lepra reaction and ulcers as recommended above The writer has found that careful administration of sulphones will often relieve in a comparatively short time patients who have been in pain and discomfort for years Vitamin B_1 concentrate injections may also be tried For local application to ulcers a paste consisting of 1 in 3 sulphonamide with cod liver oil or other form of vitamin A mixed with the base has been found most effective

Skilfully applied massage often gives great relief both in general hyperaesthesia and in localised pains and patients have sometimes with mutual advantage been taught to massage each other Infra red radiation and the application of heat are also useful but the latter must be used with great care as anaesthesia makes the patient unconscious of excessive heat (For details of massage and electric treatment see Dow 1935 or Cochrane 1947)

3 *Pain in Bones*—Gnawing discomfort especially in the ends of long bones will often keep patients awake at night This also generally results from the congestion of lepra reaction and should be treated accordingly Sodium salicylate with sodium bicarbonate in large doses orally is sometimes useful but sulphone treatment is usually most effective

Pain is often caused by bone abscesses or by chronic ulcers affecting the bones of the hands and feet Patients with tender sores of the feet by walking so as to take the stress off the painful parts will often strain other bones joints or muscles and thus set up secondary pains For treatment see p 133

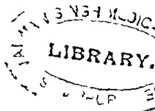
It must be remembered that leprosy patients are as liable as other patients to ordinary painful conditions—rheumatism fibrositis etc

4 *Pain in the Eyes and Nose* are two of the most distressing complications of leprosy These have already been discussed on pp 134 135

Reference is made to the beneficial results of insulin and especially of benadryl in relieving reaction and pain in the section above on the treatment of lepra reaction (p 136)

PART III

THE ANTI LEPROSY CAMPAIGN



CHAPTER TWENTY ONE

General Principles *of* Control

THE manner of transmission of leprosy has already been discussed in Chapter Three It is generally agreed that it is much less communicable than tuberculosis the disease which may be considered next of kin

The determination of whether or not leprosy spreads in a community depends chiefly on three main factors the leprosy consciousness of the people their integration and subjection to law and order and the established standard of living and sanitation

1 LEPROSY CONSCIOUSNESS

This factor is likely to come earlier in the progress of a people than high standards of living and sanitation Even when these standards are low or at least primitive it will sometimes eradicate or at least control the disease

By leprosy consciousness is meant fear of the disease, along with awareness of how it is spread and of effective method of preventing its spread When along with this there is determination to put these methods into effect then leprosy can be at least temporarily controlled

Control in England—In England in the fourteenth and fifteenth centuries sanitation housing and personal cleanliness were at a lower level than they are to-day in countries where leprosy still continues to spread And yet this disease once so prevalent in England was during these two centuries brought under control

Various elements may have contributed to this result but the principal factor was the growth of a definite understanding and fear of leprosy and realisation that its spread

could be controlled by stopping contact between the victims and the healthy population—particularly children

Perhaps reading in the newly translated Bible of the measures taken by the ancient Hebrews to control leprosy (p 3) may have contributed more than anything else to this growth of leprosy consciousness

The attitude of the Church at that time the leaders of the people is exemplified in the Leper Mass To ensure his exclusion from the community the sufferer was declared dead to the world, and the solemn funeral service was pronounced over him Also many local statutes were enacted to enforce some degree of isolation—these being among the earliest public health measures to be taken in England (*Weymouth 1938*)

Control in Primitive Tribes—Various customs with the same objects in view are found among primitive tribes in India and some parts of Africa, where from time immemorial they have been aware of leprosy and have adopted measures for its control These measures vary widely in their effectiveness and in the degree of humanity or cruelty employed

Thus in some of the Central Indian States patients are driven out of the community, unless they are wealthy or influential enough to obtain exemption In the Naga Hills patients are allowed to visit their relatives by day, provided they conform with the rule of leaving the village before nightfall

Brown (1937) tells of the dread of leprosy among some African tribes They are afraid even to utter the word for leprosy opo lest it bring on the disease In some towns the elders hold periodic inspection of all the inhabitants Anyone who is always fully clothed is under suspicion and at village feasts native costume (loin cloth only) is the official dress In some cases a grave is prepared just outside the weak leper s house and he is pushed into it while still alive immediately after death the grave is closed the house broken up and a fire lit over the grave to destroy the sickness as it leaves the body to enter someone else

The barbaric plan of Chinese military rulers—a firing squad and a quick lime grave—perhaps in the end caused less suffering than other measures exercised even in Christian countries

In planning control among primitive people it is important first to study their ideas regarding leprosy These are sometimes a strange mixture of knowledge and ignorance In Sierre Leone a chief at my request gathered from among his subjects 37 patients suffering from skin diseases When asked which of them had leprosy he picked out without hesitation the only 7 cases present some of them early and not easy to recognise Yet this same chief in his attempt at control had isolated only 1 patient and he was found on inspection to be a case of deformity from previous yaws who had never suffered from leprosy This patient had moreover with him in his isolation hut his six young children all of whom he might have infected had he actually been a case of leprosy requiring isolation (see Fig 66)

Another intelligent African in the same region when



F 66

I w pat nt l t d out d th ll ge a uppos dly nf t u ca f l p y n mpany w th h s u ept bl l ld

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Another intelligent African in the same region when



Fig 66

[illegible]

questioned as to the cause of leprosy said it was the con sequence of disobeying some tribal taboo When pressed further as to whether he would allow his young children to associate with a neighbour suffering from leprosy he said No they might get infected from the excretions of the patient There was thus in his mind a disturbing conflict between tribal tradition and practical knowledge This same man, when asked to describe leprosy, said There are three kinds—one with round patches like ringworm the second with deformities of the hands and feet and the third with lumps on the face and limbs Asked which of these was most dangerous he replied (the complete opposite to the actual facts) that the kind with deformities was worst, that with rings was next in danger and the form with nodules was the least dangerous of all He also stated that children under ten did not contract leprosy but that around puberty the child was *infected by the parent who about that time began to show* deformities in place of nodules This intelligent observer was correct in his observations, but altogether wrong in his conclusions, the child, it was true developed leprosy at puberty, but he had been infected by his nodular parent *in* infancy

These are only a few examples of the many misconceptions which partly frustrate the well intentioned efforts of primitive people to control leprosy

2 Integration and Law and Order

Leprosy belongs particularly to a certain stage in the development of a people At an early stage there is tribal or village rule in small integrated units where law and order however primitive are more or less effective If leprosy appears among them the community soon becomes conscious of it and reacts against it thus infection is brought under control, *if not entirely eliminated*

When however, disintegration of the tribal unit begins when its members find work in outside industrial concerns and Western education (often not too wisely arranged) breaks down the authority of the local chiefs and weakens time honoured customs then it is that leprosy tends to increase

as an epidemic until some new form of law and order takes the place of the old

For this reason pilgrimages wars slave trade recruitment for industrial labour and whatever else causes large movements of population—all these are apt to cause an increase of leprosy and to interfere with measures for its control

Thus in the British Caribbean area leprosy is common only in the colonies where there are large industrial plants which create a floating population In Tobago for instance where the quiet village life still exists leprosy is completely controlled whereas in the neighbouring industrialised and much more wealthy island of Trinidad it is still a widely endemic disease In Jamaica where the parish system of local self government is well developed and there are no large industrial plants leprosy is tending to die out and is much less common than in Trinidad and British Guiana

In the *South African Union* compulsory leprosy laws apply universally In the reserve area of the Transkei where the tribal system is effective the law has seldom to be invoked But in the industrial area of the Rand where tribal influence has disintegrated the authorities find compulsion necessary to bring about control

Compulsion—The question whether compulsion should be used is an important but difficult one In countries like India or Nigeria where the number of cases is so large (p 14) that only a small fraction can be admitted to institutions compulsory segregation imposed by the authorities would for want of accommodation be impossible at least on a large scale Suasion (whether moral or physical) can however be exercised in an integrated community where control is exercised effectively by the unit as a whole (caste clan tribe village town) or by its chief or acknowledged leader as is shown in the Transkei (see above) and in the anti leprosy campaign in Eastern Nigeria (p 155)

The Norwegian plan of control has been taken as a model in many other countries There in the second half of the nineteenth century patients who observed certain rules for domiciliary isolation were allowed to stay at home where they were inspected and treated by the public health

authorities those who infringed these rules or had not the facilities for carrying them out were *isolated in institutions* (Lie 1940)

The following rules as regards compulsory and voluntary isolation are recommended —

(*a*) Where leprosy is not endemic compulsory laws are unnecessary but if there are many imported cases *notification may be advisable, and adequate provision* should be made for all patients unable themselves to arrange for suitable treatment care and isolation

(*b*) In endemic countries where the number of cases is so great that all who voluntarily seek admission to institutions cannot be accommodated it is well to have a statute like that in India which can be put into force in a limited area if or when there is occasion

(*c*) In countries where leprosy is endemic but the number of open cases is not in excess of accommodation in institutions laws should be in force which provide for compulsory isolation when necessary, but every effort should be made to arrange for effective voluntary isolation either in the patient s own home or in an institution

The degree to which *domiciliary* treatment can safely be permitted depends chiefly on the facilities available for outside treatment the intelligence and trustworthiness of the patient and the adequacy of the public health service to supervise and enforce rules (Home Isolation 1945)

Institutions should be made as attractive as possible regarding treatment diet housing amenities etc so that patients may be attracted and seek voluntary admission (see Chapter Twenty five)

3 Standards of Living and Sanitation

Of the three factors on which the control of leprosy depends this is the most important and the most likely to give permanent results Perhaps there is nowhere that it can be

better studied than in the *United States of America* As a new expanding country it has received immigrants from foreign lands in some of which leprosy was and still is prevalent Some of these immigrants inevitably suffered from leprosy

McCoy (1940) in his study of the epidemiology of leprosy in the U S A shows the results of this immigration in five different regions which vary in the standards of life and sanitation

In four of the north western States but chiefly in Minnesota between 100 and 200 persons with leprosy immigrated from Norway in the last half of the nineteenth century The health authorities took no precautions except to impress on these persons the old precept of cleanliness first and cleanliness last—own bed and bedclothes own table utensils and if possible own room In 1898 it was reported that among 78 children born to these immigrants in the State of Minnesota no case of leprosy had developed nor had there been any conjugal infection In all the States 7 cases occurred in American born persons the first in 1895 and the last in 1916 and only one doubtful case in the second generation

In the city of New York where half a dozen cases are reported to the health authorities annually a careful study of at least 100 cases showed that with the possible exception of 2 there were none that could beyond reasonable doubt be attributed to infection acquired in New York or indeed anywhere else in the north eastern part of the United States

In California the records of the State department of health show 475 cases of leprosy from 1913 to 1940 but not more than 14 of them were infected in California Of 287 reported between 1920 and 1934 54 per cent were born in Mexico 13 per cent in the Philippines 7 per cent in China 4 per cent in California 3 per cent in Hawaii and 2 per cent in other States of the U S A

In the Mexican Gulf Coast States especially Louisiana Texas and Florida there is a marked contrast with the above The lepers from Louisiana (259 cases in the period 1913 37) and from Florida (65 in the period 1911 37) are nearly all infected within those States In Texas with at least 159

cases from 1920 to 1937 while many were infected in the State, at least 26 acquired the disease in the Mexican Republic

In Charleston S C, there are continuous records of deaths of lepers since 1821, all with two exceptions being infected locally Nine deaths were reported in the twenty five years ending with 1848, and 10 in the twenty five years ending with 1937 although the population had more than doubled during that period No serious attempt at control has been made so this reduction has been due to the operation of natural causes

The records in the first three regions cited—where in spite of a constant immigration of cases from without the disease does not spread or at least dies out in the second generation—are in marked contrast to those in the last two Legal regulations vary from State to State but in none of them does there appear to have been a careful follow up of cases or really serious efforts to prevent contact

It is evident therefore that the main difference rests on the standards of living and sanitation, which are sufficiently high in the first three, but not in the last two regions to prevent the spread of infection (p 17)

While leprosy may be chiefly confined to a small section of the community or even to a few families living in unhealthy circumstances, its insidious onset makes it a possible danger to all classes even to those whose standards are beyond reproach Leprosy control is accordingly, a matter of particular concern in countries where there are found side by side great wealth and poverty, with contrasting high and low standards of education, hygiene housing etc

CHAPTER TWENTY TWO

Leprosy Survey

HISTORY OF CONTROL METHODS

ATTEMPTS at controlling leprosy are found through the ages from the dawn of history Expulsion without the camp was the preventive measure taken by Moses for a highly infectious malady called leprosy in the English Bible but the description of which does not tally with the disease caused by Hansen s bacillus (p 5)

In mediæval times wealthy patrons often erected and endowed lazarettes partly it is said as the result of pious devotion based on a mistranslation of the description of Christ in the Prophets Yet we did esteem him a leper (Isaiah liii 4)

The Leper Mass and the prophylactic measures it entailed are mentioned in Chapter Twenty one as are also methods used by primitive peoples in India Africa and elsewhere

The spirit of mercy was revived in the nineteenth century when Father Damien gave his life to the care of the much neglected Hawaiian victims and the account of his heroic life and death stimulated new endeavours on the part of Christian missions Chief among modern efforts are those of the Mission to Lepers In all these activities however the aim was primarily the provision of an asylum or refuge leprosy being regarded as an incurable disease

In the twentieth century the possibility of treatment with a view to recovery gradually dawned Chaulmoogra oil which for centuries had been used in India orally and by inunction began to be given by injection Favourable results obtained in many cases stimulated scientific study and led to further knowledge of the disease

At first modern scientific study revolved round efforts at further improvement in treatment and attempts to culture Hansen's bacillus *in vitro* and inoculate it in animals But dearth of success in these directions (p 7) turned the attention of workers more towards study of leprosy in the field and emphasised the importance of thorough, prolonged and repeated survey as the first step towards leprosy control

The Need for Leprosy Survey

In the last chapter we explained that in some countries leprosy is endemic in others in spite of the presence of imported cases it is non endemic while in some endemicity varies in different parts from zero to a considerable incidence

Not infrequently public health authorities in endemic areas have acted on the supposition that leprosy can be controlled through notification of open cases by medical practitioners in the ordinary course of their practice steps being taken to isolate cases only after such notification has been given There are two main reasons why this is not adequate lepromatous cases are often infective for a considerable period before the disease is suspected, and even when patients know their condition they not infrequently conceal it Thus the seeds of the next generation of leprosy are already sown before effective steps at isolation are taken

It has been shown above that leprosy belongs to an intermediate stage in social progress between the tribe with its primitive laws of control and the modern State where good hygienic standards prevent the spread of infection In the latter the ordinary health statistics and the follow up of reported cases are sufficient But when leprosy is endemic control cannot be accomplished apart from well planned and persistently carried out measures, of which surveys form one of the most important

In planning a survey it is necessary first to determine definitely what is to be the main purpose Much time and money have often been wasted because this was not clearly thought out The principal objective may be either (*a*) to control leprosy in the area surveyed or (*b*) to add to our general knowledge of leprosy by solving such problems as the

effect of diet overcrowding familial contact or the role of insects in transmission The first of these two objectives does not exclude the second but the second by excessive attention to detail—much of which may be of secondary importance—may render the survey useless as a means of control Many meticulous survey reports have been neatly docketed pigeon holed and forgotten A leprosy survey even though its sole object is to gather information should be fitted into the setting of a campaign against the disease otherwise the co operation of the patients and the community will be prejudiced and the information inaccurate and hard to obtain

TYPES OF SURVEY

There are two main types of survey extensive and intensive The extensive type designed mainly to gather a general idea of the frequency of the disease depends on the examination of (*a*) cases of leprosy known to doctors officials and others (*b*) groups such as school children prisoners conscripts etc (*c*) contacts of known cases

An intensive survey includes complete examination of the entire population of an area by a trained staff either in clinics or preferably in the homes of the people

Except in a very small or well regimented community it is useless to attempt an intensive survey without a considerable amount of preliminary preparation It is generally best to begin with an extensive survey which in addition to winning the confidence and goodwill of the people gives a general idea of the frequency and incidence and acts as a guide in choosing small limited areas where intensive survey can most profitably be begun

EXTENSIVE SURVEY

The P T S Method —The Propaganda Treatment Survey (P T S) method based upon the system of tuberculosis dispensaries initiated by Sir Robert Philip in the beginning of the century was first begun in India under the Indian Council of the British Empire Leprosy Relief Association and has since been used in modified forms in other countries It seeks to attract rather than compel and patients are best attracted

by hope of recovery or at least of alleviation Arrangements are therefore made for *treatment* from the outset, for there is no better way of winning confidence When there is a proportion of early tuberculoid cases these can generally be cleared up in a comparatively short time with intradermal *injections* of hydnocarpus oil, and this increases the confidence of the patients and public alike

Once co operation has been won patients can be followed up to their homes and contacts examined Thus gradually as results are seen the more hesitant come forward and the *initial survey is completed*

But along with treatment and survey a third item is added propaganda or *education* Ignorance and superstitious beliefs block the progress of the campaign, and these can best be countered by education based upon the demonstration and interpretation of local findings (Muir 193-)

The African or Indian villager is generally a shrewd *observer* of facts , it is in *interpretation* of facts that his prejudices lead him astray (p 145) He fears the deformities so common in patients whose infection has almost or entirely died out , he considers children immune from leprosy because the infection in infancy often does not show till adolescence , he judges the lepromatous case harmless, at least until dis *figurements begin to appear (Fig 66)*

General teaching may not produce results but *special teaching* based upon the history of cases under treatment is more likely to carry weight , and, if the history of the gradual progress of leprosy through his own village or area can be worked out and demonstrated the patient and his friends cannot help being impressed

In this way, through a combination of treatment, propa ganda and survey *each helping the other* not only is the required information gleaned but leprosy consciousness is inculcated and the foundation of ultimate control is laid

All this requires time and labour but an attempt to *force* the pace is likely to stultify itself It should also be observed that a survey as an end in itself is apt to be sterile and a waste of time in addition it should be made a step towards ultimate control

It should be emphasised that the P T S method is not of itself capable of bringing about the control of leprosy All that it can do is to lay a foundation on which more per manent measures can be built In so far as it breeds leprosy consciousness it is of value in limiting the spread of infection But unless intensive measures (institutional or local segregation intensive survey etc) are built upon the primary extensive survey permanent results should not be expected

The ultimate control of leprosy in India with its calculated 1 200 000 cases of leprosy some 240 000 of which may be open cases can only be hoped for after a long period The three elements required—leprosy consciousness local community integration and high standards of living and hygiene (p 143) —are hard to come by in these days The disintegration of the caste system the improvement of communications and the general impact of Western Civilisation—these three are gradually removing the authority which has ruled Indian society for centuries Unfortunately primary and basic instruction has lagged behind secondary education and alongside of the high standards of the educated few the vast majority are still deep in ignorance and superstition debt and disease War has still further eroded the village economy and even the blessings of peace and the control of epidemics have by increasing the population still further lowered the standards of living

The new formed countries of India and Pakistan have some tremendous problems before them and of these leprosy is one of considerable importance A great opportunity lies open to her young men and women of education especially to the doctors who so often crowd into towns instead of seeking service in the villages where their help is so much needed It may be that their new found freedom will inspire them to this sacrifice and Western countries must not be backward in affording help if it is required

Eastern Nigerian Village Settlements—One of the most effective systems of leprosy survey and control is that adopted in Eastern Nigeria and particularly in the Owerri Province (Davey 1945) This method is on a provincial basis

In the Owerri Province there is a fairly dense population

of over 2 000 000, and a high frequency of leprosy calculated at about 75 000 or 35 per 1 000

In the first place a leprosarium was founded on a suitable site patients being admitted on a voluntary basis Within a



Fig 67

Owerri Province of Nigeria First chief to co-operate in Village Settlements and local control

few years the number of patients rose to 1 500 and it was realised that this was as large a number as could be effectively controlled in one institution More patients however sought admission and other methods had to be devised for dealing with them

This was done by using the leprosarium not as an end in itself but as a centre from which anti leprosy activities could be extended throughout the province Far reaching con nections had already been made through patients admitted from most of the villages and especially through recovered patients who had spread the news of effective treatment

When a chief applied for help for the patients in his chiefdom he was told that treatment would be arranged provided he

was prepared to erect a simple clinic building and also isolation quarters for his leprous subjects at a suitable distance from the village (Fig 67) This being agreed to the doctor made with the chief s assistance a complete leprosy survey and all open cases were lodged in the new quarters These had been erected under supervision of African inspectors trained in the leprosarium but all the work was done by the villagers them selves Likewise treatment was arranged for all patients (open and closed cases) in the local clinic building Thus the village clinic and settlement system was begun

The news of these arrangements with the first chief soon reached the ears of other chiefs who in turn agreed to erect similar clinics and isolation villages These have now after a few years become scattered over four out of the six divisions of the province and in these four divisions 18 554 cases have been brought under treatment and control

At first one of the chief difficulties was the recruitment of reliable inspectors but these posts have now been satisfactorily filled by Africans returning from war service

Through this system the knowledge of the nature of leprosy and of anti leprosy measures is brought to the homes of the people and their own responsibility and participation in the scheme impress them far more than any hearsay propaganda could do Not only do the people become leprosy conscious but at the same time methods of hygiene improved agriculture and education are introduced Further details are given on p 167

It must be pointed out however that the Eastern Nigerian system is dependent for its success upon the integrating power of the tribal system and the remoteness of the region from large industries and other influences which would cause considerable movement of population and break down the power of the chiefs and elders over their tribesmen

This system shows the combination of a gradually developing survey with permanent arrangements for the control of leprosy

Survey of School Children

One of the most effective methods of conducting a pre liminary or extensive survey of leprosy is by examining school

children The writer examined most of the schools in the colony of Trinidad and Tobago with interesting results (Muir 1942 1943) Almost all the schools were primary the pupils being from 4 up to 16 or 17

Examination was made with the assistance of the public health and school nurses, and in many schools also the school doctor was present Later the school doctor made the pre liminary examination and then discussed with me all doubtful cases In almost every school the teachers gave full *co operation*

One of the chief difficulties was absenteeism many pupils attending school only three or four days a week It was found advisable to arrive without the previous knowledge of the children, otherwise some who knew they had leprosy might stay away Most of the school buildings consisted of one or more large halls, in each of which several classes were held It was therefore found convenient to carry a few large sheets which were used for screening off a corner for exam ination The youngest children were first examined all being stripped and lined up A good light is essential and generally *the child stood on a stool so as to make the lower parts more* easy of examination Parts were examined in the following order (front aspect) face neck upper limbs (feeling the ulnars at the elbow) trunk, lower limbs (feeling the peroneals behind the knees) *(back aspect) from above downwards in* the same order Other skin conditions (scabies, tinea yaws nevus etc) were noted as were signs of malnutrition enlarge ment of spleen and the state of the eyes It was found possible with good assistance to examine as many as 100 pupils in an hour

In one school where 300 pupils were examined 9 cases of leprosy were found By examining home contacts of these cases several others some of them open and infective, were discovered

The great majority of cases were of the tuberculoid type The more extensively affected of these and the few lepro matous cases were sent to the leprosarium while the earlier tuberculoids were treated as weekly out patients at clinics

These surveys and the arrangement made for outside

treatment were found to create a certain amount of leprosy consciousness as is illustrated by the following example A school had been surveyed and 3 cases found One of these was a boy with a lesion below the knee After a few weeks treatment with intradermal hydnocarpus oil this lesion began to fade At this time the writer was asked to go to the village where the boy lived to see a woman—an advanced lepromatous case—who had eluded the visits of the sanitary authorities for some months On arrival at the village I received to my surprise every assistance from the villagers They assured me that they would see that the infectious woman did not escape but would be present when the ambulance came to take her to the leprosarium Then several of the villagers began to show tuberculoid lesions on themselves and their children, and soon 9 new cases were assembled This co operation very different from the usual attempts at concealment was the result of the diagnosis treatment and improvement of this one boy and the realisation by the villagers that they and their children had been infected by this woman with whom they had been accustomed to associate freely

School survey when this can be accomplished with the co operation of the educational authorities forms a rapid and fairly accurate method of finding out the areas of highest incidence and by examining the home and other contacts of affected children of locating the foci of infection It also gives an opportunity for educating the public in the nature of leprosy and the methods of control The writer found that crowded audiences would attend evening lectures on leprosy held in local schools parents having been interested and induced to attend by their children

CHAPTER TWENTY THREE

Leprosy Survey—*continued*

INTENSIVE SURVEY

IT will be clear from what is related above that an intensive survey of the whole population in an area can only be undertaken after the confidence of the people has been won and a certain amount of leprosy consciousness engendered Exceptions to this are in very small or regimented communities Thus in the Belgian Congo the villagers have in some cases been transferred from their original locations and settled along the main motor roads The people in these areas are very dependent on the Government for their livelihood and it has been found possible to make a complete survey—*economic anthropological health etc leprosy being* included in the list

On the other hand it will be recognised how easily and thoroughly an intensive survey can be conducted and repeated when necessary in communities such as those described in Eastern Nigeria (pp 155 167), where the chiefs are co operative and their power over their subjects is effective where also the benefits of leprosy treatment and control are already self evident

Example of a Survey—The method of making an intensive survey may be further illustrated by reference to a study made by Doull *et al* (1936) in the Philippines The area chosen was in a small island and had for some years been the seat of an anti leprosy campaign so that the area was well defined and the ground well prepared

The objects of this field study were sevenfold and cover many of the important points to be ascertained in any intensive survey

1 The frequency of leprosy and the ratio to the number of cases previously known The population examined was 6 063 persons and 104 cases of leprosy were found Of these 43 were already in segregation and 16 had been released on parole Of the remaining 45 there were 15 closed cases already on the clinic register The total incidence was 17 2 per *mille* or excluding 23 arrested or quiescent cases 13 4 per *mille* It was calculated that if there was the same ratio between segregated and non segregated cases throughout the Philippines then on the basis of those already segregated (approximately 8 500) the total number (including active and quiescent cases) would be 20 000 more or less

2 Of the 45 new patients discovered 3 were bacteriologically positive and 42 negative From the area however other 43 positive cases had previously been segregated

3 There were also 16 cases at home on parole who had formerly been positive in them the disease still appeared inactive (quiescent)

4 There was a history of house contact with a leper in 38 5 per cent and of family contact in 26 per cent Histories of contact outside the home were considered in an area such as that under survey as being of little value

5 As regards the relative infectiousness of open and closed cases it was found that per thousand person years 6 5 was the attack rate with open cases and 2 5 the attack rate with closed

6 The primary (first seen) lesions were generally on the more exposed parts of the body

7 No predisposing diseases were found to account for high incidence except for yaws and other parasitic skin diseases but a suggestive association was found between the occurrence of leprosy and overcrowding in the home

Data for conducting an intensive survey are given in *Appendix II* *For Contact Rates see p 11 and for Type Age and Sex Rates see Chapter Four*

REPETITION OF SURVEY

Data of much value can be discovered by comparing results of surveys *in two areas between which there is one or more* contrasting element

Data of a different nature can be gathered by repeating the survey in one area either annually or after a period of, say five years This is particularly useful when the resurvey is made in two largely similar areas in one of which during the interval active control measures have been conducted while in the other nothing has been done

A resurvey may bring out the effect on leprosy of a wide spread disaster such as famine or an epidemic occurring in the intervening years Such an event is generally found to cause the immediate death of the weakest among the lepers and therefore a lowering of the lepromatous rate This may be followed more slowly by an increase in the lepromatous rate caused possibly by the lowered resistance of the population (Report 1945, Bray 1934, see also p 15)

LEPROSY CLINICS

References have been made above to leprosy clinics in connection with the P T S system (p 153) village settlements (p 156) and school surveys (p 158) The clinic is a most important factor in the control of leprosy, and its functions are here discussed (see Lowe, 1933)

In some places it is found advisable to avoid the word leprosy and it is called a skin clinic so that no opprobrium is felt by the patient in attending

The functions of the clinic are —

(*a*) The treatment of fairly early closed cases which do not on account of the advance of the disease or because of complications require hospital or institutional care

(*b*) Treatment of open cases under domiciliary arrangements (pp 147, 148)

(*c*) Inspection of (i) patients who have been discharged from institutional isolation with the disease quiescent (ii) known contacts of open cases, especially children, (iii) suspected cases

(*d*) Lists should also be kept of absconders from treatment or isolation

(*e*) There should be a detailed list of all cases under institutional treatment

Lists under all these categories should be kept up to date and when necessary patients and others visited at their homes for treatment or inspection Patients moving from one area to another should be notified at the clinic concerned

The clinic is an essential element in leprosy survey By it patients are attracted and the survey initiated in it the information gathered is tabulated and kept ready for reference through it this information is constantly corrected and supplemented

Leprosy Authority

In an endemic country which is large enough to employ several medical and other leprosy whole time workers there should be an Authority, generally in the form of a Board This should include in its membership representatives of official voluntary medical administrative and other bodies concerned The success of the anti leprosy campaign has frequently been vitiated by a vacillating policy—lack of foresight co ordination and continuity The Board should be so constituted as to avoid these dangers and its executive officer should be carefully chosen with this in view

The Authority should be ultimately responsible for the initiation and establishment of surveys clinics institutions and all the other activities of the campaign against leprosy

Co operation of Medical and Health Services

In most endemic countries leprosy was for long considered to be a subject for charitable organisations or failing them for the police It is only in recent years that it has been classed with other infective diseases as a responsibility of the public health authorities In India in 1925 leprosy was classed with insanity blindness and deaf mutism as an infirmity —not a disease At that time doctors took little or no interest considering leprosy incurable and not amenable to treatment On its formation in 1925 the Indian Council of the British Empire Leprosy Relief Association arranged for classes to be held for members of the medical profession at which a two weeks practical course in leprosy was given twice

a year at the School of Tropical Medicine in Calcutta Each course was attended by some twenty five to thirty doctors from all parts of India many of them being themselves teachers in medical schools and colleges Later, other courses were arranged in provincial centres and teaching on leprosy was introduced as part of the medical curriculum

In most countries where leprosy is endemic, instruction is now given not only to doctors but also to sanitary inspectors and health nurses With their help it is possible to complete the gaps in survey and facilitate the control of the disease

However, a certain amount of prejudice still persists and cases of leprosy are often banned from admission to general hospitals where tuberculosis although on the whole much more infective is admitted On the other hand, when leprosy is admitted the obvious simple precautions are in the writer s experience often neglected

CHAPTER TWENTY FOUR

Organising Control Measures

THESE must necessarily vary greatly with the incidence the size of the area and density of the population the education and standard of living and sanitation and with the availability of suitably trained doctors and other personnel and of adequate finance

It is generally agreed that in an endemic area there must be a central residential institution often called a settlement colony or leprosarium But there are two main schools of thought as to the nature and functions of this institution

1 THE CENTRIPETAL SYSTEM

The first of these which I shall call the centripetal system may be considered an end in itself It accepts the patient voluntarily and gives him as far as possible a normal life in conditions based upon his accustomed home system but in more sanitary surroundings It gives him treatment and arranges useful work for him according to his ability work for which he is paid He is thus able to a large extent to earn his living and maintain his self respect This method hopes by attracting patients and isolating infection gradually to eliminate the sources of infection from the area served Patients who have recovered return to their homes and spread the news of the chance of recovery and in this way there is a constant influx of patients

This form of institution is a very definite advance on the earlier home or asylum which aimed at giving refuge to victims of a hopelessly incurable disease But it does not go far enough while it is beneficial to the individual it fails to get down to the root of the disease in the village community

We have mentioned already that the lepromatous type of leprosy becomes infectious long before it becomes conspicuous

or readily recognisable Even when it is recognised it is often not convenient for the patient to leave his family land employment and the many other things which bind him to his ancestral soil Thus although a dozen patients from a village may have been safely isolated in the leprosarium one or two infectious cases left behind can like a few weeds left in a garden seed the next generation

Another fault of the centripetal system is that the more attractive the institution the more patients it enrols, and the area from which they are drawn may be wide and ill defined From this there are two dangers —

(*a*) The institution tends to become too large and thus unmanageable The power of lepromatous cases to spread infection tends to increase in direct proportion to their aggregation, unless a definite minimum of control is constantly exercised The exercise of *that minimum of control becomes increasingly* difficult when the numbers exceed about 1 500 unless the institution is effectively isolated from the surrounding inhabitants by some barrier difficult to penetrate

(*b*) In attracting patients from a wide and undefined area a movement of leprous population is set up There is apt to be coming and going especially along certain lines of communication, and a leprous patient when travelling through areas where he is unknown is a greater danger to his possible contacts than when he remains within his home where his condition is known Also there is a tendency for patients to *settle more or less permanently* in the neighbourhood of a leprosarium if no strict super vision is taken to prevent it

The dangers of the really attractive centripetal leprosarium are therefore its unwieldy size its insufficiently controlled and somewhat diffuse margin merging with an outside area which tends to have unusually high endemicity and incidence and its long and unguarded lines of communication with the homes of its widespread clientele

2 The Centrifugal System

The alternative method which we have called the centrifugal system has already been described in some detail on pp 155 157 It may be compared to a wheel of which the leprosarium is the hub limited in size and radiating out its activities to a definite rim which encloses a clearly defined area The leprosarium is a central institution which treats and cares for a limited number of patients—between 750 and 1 500 has been found an economical and practical number From the central institution are served numbers of smaller centres scattered at convenient spots throughout the whole area Each of these small centres represents a village group of villages clan or other cohesive and organised social unit It consists of a clinic for the treatment of all patients within the unit area and a small settlement where the local open cases are housed

Healthy children of patients are strictly excluded from this small settlement though sometimes the healthy husband or wife may be admitted

If this system of small village centres is to be a success the principle of self help must be carefully engendered Clinic and settlement buildings arable land and whatever else is necessary for the life of leprous patients must be freely supplied by the community itself and the relatives with when necessary small grants from the local administration The leprosarium supplies help and supervision in choosing the site clearing the land and erecting the clinic and clan settlement it also arranges a complete survey and determines which patients require isolation and which may remain at home It provides treatment arranges welfare service sees that children of open cases are cared for by relatives or failing thi are provided for in the central institution Inspectors are appointed who live in the neighbourhood give treatment and see that the rules about isolation and general hygiene are adhered to

It may be asked under what authority all this is done Is there any law compelling obedience? The answer is—not necessarily But much will depend upon the integration and co ordination of the community referred to at the beginning

of this section When this is adequate force from outside is not necessary and any suasion required will come from within the community itself, backed by the personality of the staff

Davey (1945), who has worked out the system in Eastern Nigeria writes of difficulties when co operation is not obtained

The one clan not concerned with leprosy work is the Igbo a large clan in parts of which there are many people suffering from leprosy There is little unity among the elders in the clan, and this is holding up progress not only where leprosy is concerned Perhaps the beneficial results obtained in surrounding co operating clans will in the long run compel the attention even of the Igbo

CHAPTER TWENTY FIVE

The Leprosarium

THE word leprosarium meaning leprosy sanatorium though not very satisfactory is used for want of a better term Other terms have been discarded —asylum or home (implying abandon hope of recovery) colony (also suggesting permanent residence) settlement (with the same objection and also associated with the word penal) hospital (few patients require hospitalisation) Sanatorium is nearest the mark like a tuberculosis sanatorium it seeks to train *the patient and if possible to return him to his former surroundings* with the disease under control if not completely arrested

The writer has visited leprosaria in all parts of the world Some of these are luxurious and costly while others like those in East Nigeria are on a much more modest scale where patients erect *their own* houses with material from the bush at a cost of only a few shillings each

These differences are due chiefly to the comparative wealth or poverty of the countries concerned But one is struck with the fact that the efficiency co-operation and *cheerfulness of the patients and the success* of the results obtained are not in direct ratio to the money expended in erection or maintenance Given a necessary minimum of facilities the best results are much more dependent on the voluntary admission of patients and the devotion and *selflessness of the staff*

Before a *leprosarium* is erected it is important that a general (extensive) survey should first be carried out so as to gain reliable *information* about the *frequency* and *distribution* of leprosy and the location where the institution can most conveniently serve *the interests of the patients* and *bring about* the control of the disease A series of small test surveys is the

best method, as it quickly gathers the necessary basic facts Once the site has been chosen, erection of the leprosarium and the extension of the survey can be continued together, the one contributing to the other

THE SITE

It is important that great care be taken in selecting a site The writer has frequently seen expensive buildings erected on what has proved to be an unsuitable location There are five main requirements in choosing land —

1 The site must be *healthy* or capable of being made and kept healthy This has special reference to insect borne diseases like malaria filaria and sleeping sickness If necessary the advice of an expert should be sought as a place healthy at first may become unhealthy as patients infected with various strains of malaria are admitted The presence of undrainable swamps in the neighbourhood is a particular danger The climate should be temperate with moderate breezes and fairly low humidity

2 There must be *sufficient land* suitable for *building* and for *agricultural* purposes This will depend on the minimum number of patients finally to be admitted and on the quality of the soil and it should be remembered that it is often difficult or impossible to acquire more land later on There should be enough space so that the healthy staff can be housed far enough away from the patients, keeping in mind the danger of infection and also their need for relaxation

In most endemic countries agriculture is the main occupation of the patients thus there should be plenty of good arable land so that patients may find employment and at the same time make the institution as nearly self supporting as possible On an average for 1 000 patients there should be at least 50 acres for building and 400 for agriculture

3 An adequate supply of good water for both domestic and agricultural purposes is necessary

4 The site should be far enough away from the habitations of healthy neighbours to prevent mixing and the danger of spreading infection The distance required will depend on

Fi 68

Mod l of a lep o m

1 H f female p t nt
M d qu t r b t e n a d
2 Houses f m l p t nt
3 St f d d t b t w k hop
4 Cl
Chu h
6 H ll
7 Ch ldr n qu t rs
8 D n g o m and k t l n
9 Wa ds f cut ca
Isolat on oom betw n 9 nd o
10 Chro w d
1 R cr at n g und
H lthy offi
3 P t t ffce
Inqu ry ffic betw n a d 3
4 Lepe t ff and well to-do p t nt
5 D t nt om



the discipline maintained in the institution and the degree of leprosy consciousness of the neighbours which must be sufficient to prevent contact In compulsory institutions greater restrictive measures are necessary than in voluntary

5 It is necessary to have adequate communications with the outside world, so that supplies may be brought without *undue difficulty or expense and so that the staff may not be* too isolated

BUILDINGS

These vary in different countries according to the funds available the customs of the people the nature of the climate and the most suitable material that can be procured

A plan is given in Fig 68, but this is only for general guidance and must be modified to suit the contour of the land, the nature of the soil and other factors

Generally speaking the buildings may be divided into staff quarters, administration and general service blocks medical buildings, social welfare buildings and the patients quarters

It is very important that before construction is begun the maximum size and population of the institution and all the future buildings likely to be required should be determined and plotted out in a comprehensive plan Thus although only a comparatively small proportion of these may be erected at first there is room for expansion and orderly development without overcrowding

In making the plan the following considerations should be kept in mind —

(*a*) *The health happiness and welfare of the patients*

(*b*) The health of the staff and their convenience so that they may be able to work with the maximum of efficiency and be saved from unnecessary strain and waste of time

(*c*) The æsthetic lay out and appearance of the institution and of its various buildings

(*d*) The degree of permanency of the buildings *must* be considered in the light of their healthiness the

customs and tastes of the patients the kind of materials and labour available the expense in erection and in maintenance

Staff Quarters—These are mentioned first as they have generally to be erected first It is important that they should be at a sufficient distance from the patients and the scene of work The duties of the staff are difficult and exacting and quarters should be sited so that the time of leisure is interrupted as little as possible and necessary relaxation is possible One cannot but admire the devotion of Father Damien who lived and ate with the patients whom he regarded as incurable and doomed He considered that he could serve them best by becoming like them and as he took no precautions he contracted leprosy Our outlook nowadays is different No less sympathy or service is required but patients must be inspired with hope of recovery and the stronger and more healthy the staff the better will be their service Also the particular danger to children must be kept in mind and precautions taken that by no accident can healthy children have contact with the disease

On the other hand staff quarters should not be unnecessarily distant and there should be convenient means of communication with the rest of the institution

Staff quarters should generally be of a permanent nature and considering the usual remoteness of leprosy institutions from the outside world they should be made as ample healthy and home like as possible

Administration and General Service—These buildings consist of the offices stores kitchen laundry and mechanical plant—electric power pumping etc These should generally be of a permanent nature and should be carefully planned from the outset with a view to expansion as the institution increases in size

Medical Buildings—These should be of a permanent nature but the degree to which specialised departments can be arranged will necessarily depend on the size of the institution and of the staff The hospital should be planned with adequate facilities for consulting rooms operation and treatment rooms

laboratory records dispensary and stores These should be placed centrally and within easy reach of each other, while the patients wards though perhaps small at first should be capable of extension without interfering with the convenience or symmetry of the buildings

Circumstances will determine whether all forms of treatment should be attended to at one central block or whether minor dressings and other forms of routine treatment should be decentralised

There should be adequate room for dentistry and for examination and treatment of eyes

Sufficient beds should be available for treatment of reactionary exacerbations and other complications for operation cases, for accompanying diseases especially in new admissions There should be some specially isolated rooms available for tuberculosis and other infectious diseases and for treatment of mental cases

There should be separate accommodation for blind and crippled patients who though they do not need hospital treatment are unable without assistance to look after themselves They may either be lodged in special wards where they are cared for by nurses or placed in cottages with other patients who are willing to attend to them

In institutions which act as a centre for a large area with small subsidiary centres there must be hospital accommodation for special cases sent in from these centres

The more recent forms of treatment with sulphones should in the end diminish lepra reaction and many of the other complications, but on the other hand it may be found necessary to hospitalise some of the more advanced cases during the initial period of such treatment

Social and Welfare Buildings consist of churches and other centres of worship schools, industrial buildings canteen or shops recreational clubs and hall These are either of a temporary or permanent nature according to circumstances All are of great importance in the conduct of a leprosarium They should aim at a life for the patients comparable with that in their homes but should at the same time supply a centre for education in the ordinary school subjects in useful crafts

in hygiene and in all that is concerned with personal recovery and the prophylaxis of leprosy

Patients Quarters —These are the most important of all and *it is in them that the greatest variety is found in different countries* In founding a leprosarium it is necessary at first to use outside labour for the erection of a few cottages for residence of the first patients admitted but in India Africa the West Indies and many parts of South America it is usual for the patients themselves to erect subsequent houses This has the advantage of giving them employment an important part of the treatment and at the same time of saving expense

In selecting the type of house for patients these considerations have to be kept in mind —

(*a*) The type of house the patient is accustomed to at home and *one he can erect himself*

(*b*) If this is of a temporary style—mud and wattle or sun dried bricks—can a similar house be made in the leprosarium which will be sanitary and suitable for the treatment of leprosy ?

(*c*) Are such houses economic as compared with those of a more permanent nature which although more expensive *on first erection will require less future repair* ?

In India the West Indies and South America houses are generally of a more or less permanent nature built with bricks cement and wood In East and West Africa where the people are more primitive and where there is plenty of raw material available in the bush mud and wattle houses with palm or straw thatch can be put up by the patients themselves at little cost and the walls and floor can be made hard and kept clean by daubing with special locally found earths

Cottages may be made single double or triple each patient having a room or two rooms or two or three patients can be lodged in a larger room This will be determined by the desires of the patients and by what they have been accustomed to in life outside

Dividin Patients —Patients quarters should be divided up under various categories age sex type of disease and according to race tribe religion and caste

It is advisable to house boys and girls under 15 or 16 in separate dormitories, generally with a senior patient of suitable intelligence and character and of the same sex, in charge

The segregation of the sexes is a difficult question In favour of complete separation of men and women there are two main considerations the tendency of child bearing to exacerbate leprosy and the danger of children born to leprous parents Against separation there is the unnatural life—the more pronounced among primitive people—to which patients are sentenced for many years, often for life Also it is sometimes *found impossible completely* to separate the sexes in spite of strict rules and precautions

Various expedients have been tried In a Korean leprosarium carefully selected patients are allowed to marry after sterilisation of the males and one or two child patients can be adopted by the married couple In other places compassionate marriage is allowed on condition that pregnancy is avoided And again elsewhere marriage is permitted without this stipulation children being removed at birth and placed either with healthy relatives or in a creche or home (Wilson 1935)

STAFF

Leprosy institutions vary so much in size and in financial backing that it is impossible to do more than lay down general principles regarding staff

No leprosarium is satisfactory without expert medical supervision The writer has seen many small institutions in Africa and elsewhere which were periodically visited by physicians who had never made a careful study of leprosy and understood little about it It is most satisfactory when the leprosarium is large enough to require at least one whole time doctor who has specialised in leprosy

There should also be a trained nurse to supervise nursing dressings etc and to train suitable patients in such work

Trained non medical workers are necessary to organise *and supervise the construction* and repair of buildings and the business industrial agricultural educational and social welfare sides of the work

For dispensing laboratory and office work healthy staff is necessary but much of the remaining tasks can with advantage be done by carefully trained patients

In a leprosarium run on the compulsory system a much larger staff is necessary as patients who are kept under constraint cannot be relied upon to perform essential work to the same extent as patients in a voluntary institution

The considerations to be kept in mind in recruiting staff are discussed on p 185

PRECAUTIONS TO BE TAKEN

There are certain simple precautions that should be taken by those engaged in anti leprosy work The mode of infection and the nature of resistance are discussed in Chapters Three Four and Five The lepromin test has been suggested as possibly giving an indication as to the resistance of a worker to the disease This is a matter which requires further investigation

The most important precautions to be taken are —

(*a*) Keep the general health at a high level Avoid malaria dysentery and other weakening illnesses

(*b*) Housing accommodation should be suitable (see p 173)

(*c*) Particular precautions should be taken when in contact with or in the proximity of severe lepromatous cases especially during lepra reaction remembering the danger not only of touch but also of droplet infection A gown or overall should be worn and rubber gloves Hands should be washed carefully after touching any case Reliance should not be placed on antiseptics (we do not know what will kill leprosy bacillus) but rather on the efficacy of the very thorough use of soap water and nail brush

A bath and change of clothes on returning home after a visit to patients is a wise extra precaution Some workers wear a cap mask and rubber boots in the writer's opinion this is unnecessary

(*d*) It is important to make a rule never to use furniture etc , or sit on seats or cushions (as in a car) used by patients

(*e*) If an open case has vacated a room how should it be rendered safe for ordinary use? Temporary houses should be destroyed by fire Permanent houses should be thoroughly cleaned with soap and water the walls scraped and replastered woodwork washed with turpentine or kerosine and repainted The house should be de infested with D D T or other suitable insecticide (see p 11)

CHAPTER TWENTY SIX

Healthy Children *of* Patients

THERE are two generally accepted facts about leprosy in children —

(*a*) *They are particularly susceptible to the disease*

(*b*) If removed from the infectious mother at birth and kept thereafter from contact with infection they will not contract the disease

Delayed removal however is dangerous even when the child remains with the infectious parent only a few days

The chance of transferring the disease necessarily varies with the type of case The tuberculoid case except when in a state of acute reaction is not likely to be of danger and the same may apply to some cases of the uncharacteristic type There is however a particular danger that a closed case may become an open one shortly after childbirth It may be taken as a general rule that the danger from the mother is in proportion to the number of bacilli that she is capable of shedding from her body (see p 12)

The care of children born to leprous parents is one of the most difficult of solution and perhaps the most important of all If the chance of infection could be removed from all children under 10 years of age leprosy would probably die out or at least become a minor disease within two generations

In Brazil more than in any other country provision has been made for the children of leprous parents (Weaver 1940) A federation of welfare societies has erected with the financial help of Government twenty seven preventoria with accommodation for 5 000 children These are well cared for under expert medical supervision and trained in various useful occupations until they reach an age when they can look after



FIG 69
Superinfect on Both parents are advanced open cases so the child is likely to develop a severe form of the disease

themselves But few countries in which leprosy is a *problem* equal to or greater than it is in *Brazil have comparable financial* resources

In India 750 children of leprous parents are cared for in homes chiefly supported by the Mission of Lepers, but this is small when it is calculated that perhaps more than 15 000 children are infected and develop the disease every year

Cochrane (1947) has made a special study of child leprosy and methods of control in the Madras Presidency Failing the possibility of complete segregation of children from open cases among male adults he has made arrangements for the latter to be lodged at night in communal quarters, letting them remain at home during the day Thus it is hoped to prevent contact at the time when it is closest and therefore, most dangerous His reported figures of surveys in four night segregation villages in 1939 and repeated in 1945 do not reveal any greater improvement than in two control villages where there was no separation The objection to this project is the uncertainty of its being carried out with sufficient regularity and thoroughness



FIG 70
Lepromatous case All three sons already show more or less advanced signs of leprosy

In Eastern Nigeria various experiments have been made in

the care of infants separated at birth from infectious mothers When satisfactory arrangements cannot be made for healthy relatives to take these infants they are kept in a creche where they are tended by non infectious women patients or ex patients Each child is suckled by its mother who after a bath wears a clean white gown covering the whole body except the nipples Thus the chance of transferring bacilli is reduced as far as possible This method is unsuitable in bad nodular cases but seems to work well when there is no more than a mild degree of infectivity The children as a rule do well and a great difficulty is overcome in a country where fresh cow's milk is unobtainable and artificial foods are expensive It is often found that relatives are willing to take these children once they are weaned and no longer require constant attention

Whatever method is adopted it should be suited to the circumstances and resources of the country and its aim should be while looking after the general welfare of the child to lessen as far as possible the chance of its contracting infection To do this it may sometimes be necessary to use a method which though not ideal in itself has no better alternative

It is sometimes found advisable to have an observation building for children who have had infective contact and who show suspicious signs of leprosy These signs have already been referred to on p 65 Absolute segregation of these children from others may not be necessary but it is well that they should be examined regularly and especially if the lepromin test is negative given careful general treatment

CHAPTER TWENTY SEVEN

Social *and* Welfare Service

AS with tuberculosis so with leprosy, for effective control there must be an efficient social and welfare service (Social Problems 1940)

The aims of such a service may be divided under three heads non medical care of the patient in the central institution care of his relatives and interests outside the institution and care of patients not isolated in a central institution In every large leprosarium there should be a specially trained officer in charge of the service (see also p 115)

THE PATIENT IN THE LEPROSARIUM

The social and welfare service should care for the patient s spiritual mental and physical well being both as an individual and as a social being The patient has entered the institution not only for his own benefit but also in order to protect the community from infection In that respect he is a benefactor to society and merits in turn benefits from society

These may conveniently be divided under four headings education occupation recreation the spiritual side

(*a*) *Education* —Leprosy has been described as a disease of ignorance and superstition It is only through the enlightenment of education that it can be effectively opposed In most endemic countries the majority of patients are illiterate Schools are necessary for children, and adults can be taught to read by one of the modern simplified methods Educated patients can generally be found who are capable of acting as teachers but it should be made a duty of the educational department to see that teaching is as far as possible efficient and does not suffer from want of equipment

Technical training should be developed and such trades taught as building carpentry masonry metal work leather work weaving tailoring basket work manufacture of locally grown agricultural products etc Improved methods of agriculture and horticulture should be developed and taught (Bevan 1940)

Practical training should be given to all patients in both general and special hygiene Cleanliness of body clothes dwelling and surroundings should be taught both by precept and through daily practice The patient should be taught the causes of leprosy its nature and the methods of treatment and prophylaxis He is more likely to carry out rules if he does so intelligently and if he recovers and returns to his village he becomes a missionary of hygiene and leprosy control

(*b*) *Occupation* —Doomed to remain for years it may be for the remainder of his life in a leprosarium how is the patient to spend his time? Only occasionally he requires hospitalisation and his medical treatment takes up only a short part of the day Patients are of different sexes ages trades and occupations some have been accustomed to sedentary others to hard physical work some are able bodied others are weakened or crippled by the disease Yet all should have occupation according to their ability capacity and as far as possible choice

The medical social and sanitary requirements of the institution will absorb a certain number of patients as nurses washers cooks police scavengers etc Others will find work in agriculture and the trades they formerly practised outside or have learned since admission

But in allotting various occupations much care should be exercised to see that each patient is employed to the best advantage of both himself and the community

Exercise especially if taken in the fresh air is of great value to the patient so if his occupation is sedentary or does not give sufficient open air exercise this should be made up by walking or some active form of recreation

Communal drill and physical jerks have been found of great value in some institutions It encourages regularity of

and helps to develop the physique, and it prevents or alleviates deformities

Occupation therapy is one of the most important forms of treatment, when wisely planned it benefits the patient in four different ways it maintains his self respect by keeping him busy, it prevents brooding and morbid thoughts it maintains his strength and general health and thus makes medicinal treatment better tolerated and more effective it helps to prevent the deformities of the hands and feet which are so liable to occur (Dow, 1940)

(*c*) *Recreation* —Patients should be encouraged as much as possible to organise team games Dancing is a favourite form of exercise in Africa, and patients of different clans or tribes often compete with each other Music, concerts and theatrical plays encourage the creative instinct and give great pleasure both to the audience and to those taking part Concerts, etc by outside artists are very popular as are also cinema shows, and these, if not too frequent, help to stimulate patients and to increase and improve their own efforts at entertainment

Suitable accommodation in the form of a concert hall and club rooms should be erected Libraries should be organised with a wide selection of books and a reading room with current journals

In all this the social welfare officer should study the capabilities of the patients, get them to form their own committees and with his guidance, organise various recreational and other social activities

(*d*) *Spiritual* —This is included in the social and welfare service and is placed last not because it is least important but because medical treatment work and recreation, if they are to function smoothly and effectively, must have a spiritual or cultural setting a wider and freer atmosphere This is well known and is freely acknowledged by governments and even by those who have themselves no religious allegiance

There are some obvious reasons for the need of a spiritual background in a leprosarium (*a*) a majority of the patients are suffering from mental depression, they have contracted a disease which they have always been taught to dread, and

they are conscious that they are looked on with abhorrence by their relatives and former associates, (*b*) they have had to leave their accustomed home occupation and all that they valued and been severed from the tribe caste or other social unit to which they belonged (*c*) the future has a gloomy prospect in some cases progressive advance of disease they are afraid of the future (*d*) with all these disturbing and disintegrating causes patients feel a need for something which will integrate them into a new society give them a new outlook and purpose in life and help them to look forward with assurance and courage to the future

A leprosarium differs from other institutions from a hospital where the patients are weak and confined to bed and are discharged after a comparatively short period as soon as they have recovered sufficient strength from a penal settlement where strict discipline is enforced for these patients have committed no crime from a mental institution for the patients are mentally normal For all these reasons the patient requires deep sympathy and understanding and great care is necessary in choosing staff Leprosy work does not appeal to the ordinary doctor nurse or lay worker The most successful personnel has always consisted of those with a sure sense of vocation and a genuine and practical sympathy with the unfortunate victims Patients are quick to recognise such qualities in the staff and respond with their co-operation

Care of Patients Relations and Interests

The patient is often the bread winner in the family One of his chief objections to seeking admission is his difficulty in arranging for the upkeep of his family and the care of his property If he is a farmer who is to look after his stock his land and crops? His house requires frequent repairs Neighbours sometimes instead of being helpful are ready to take advantage of his absence With these anxieties on his mind the patient s chance of improvement under treatment is vitiated

All this requires the services of the social welfare officer and if he can call in the help of an organised body of voluntary

helpers his efforts to smooth out such difficulties are facilitated and more likely to be effective

Care of Outside Patients

These are of three categorie (*a*) those under domiciliary treatment, (*b*) patients segregated in village settlements, (*c*) patients who have recovered but are disabled and not able to support themselves

Patients under domiciliary treatment are generally well to do and do not as a rule require much attention from a welfare officer

Those in village settlements, such as patients described on p 156, need regular attention to ensure that their wants are attended to and that agreements for the support of their dependents are faithfully adhered to

Patients who have recovered with deformity and a certain amount of disablement require careful individual attention Plastic operations and artificial limbs will often make them more nearly self supporting and with some training they can often learn useful occupations Relatives should be visited and persuaded to give accommodation and support, they must be taught what in many places is not at first realised—that deformities do not imply a danger of spreading infection In some places special institutions or parts of institutions are set aside for the care of these ex patients

Welfare Associations

In many places an association is formed with the objects of (*a*) providing entertainments and supplying amelioration for leprosarium patients (*b*) attending to their relatives and (*c*) looking after the interests of discharged patients Such an association may be of immense value in amplifying the efforts of the welfare officer

APPENDICES

Appendix One

Preparation *of* Esters

For those who wish to use hydnocarpus esters there are two methods recommended for their preparation —

1 Cold Process

425 gm of crude cold hydnocarpus oil, 550 c.c. of 96 per cent ethyl alcohol and 32 c.c. of sulphuric acid (specific gravity 1.84,) are placed in a bottle with a tight fitting glass stopper and left until the process of esterification is complete. The bottle should be shaken once or twice a day to mix the upper and lower layers. This hastens the process, as does also the placing of the bottle in the sun or in some warm place. Neither the shaking nor the heat is, however, essential if time is not a consideration. To begin with the oil forms a lower and the alcohol and acid an upper layer. As esterification proceeds a point is reached at which the lower layer, now chiefly composed of esters, gains a lower specific gravity than the upper layer which now contains a large proportion of glycerol, and the former therefore rises to the top. To ensure the completion of the esterification it is well to allow the process to continue further for the same time which elapsed between the mixing of the ingredients and the rising of the lower layer. Thus if the lower layer takes fourteen days to rise the ingredients should be left in the bottle for fourteen days longer. If a sample from the upper layer dissolves completely in alcohol it is a sign that esterification is complete, as alcohol completely dissolves esters but not oil. The lower layer is then drawn off and the upper layer is washed with an equal volume of water

twice over or till the washing water is free from acid as tested for by litmus paper It is then washed with a 0 1 per cent solution of sodium hydrate in water, which forms a thick emulsion crystals of common salt are gradually added in small quantities and brought in contact with the emulsion by slowly rotating the vessel so as to break the emulsion On standing the esters will rise to the top When this has taken place the lower layer is removed and the upper layer consisting of esters after being washed once more with distilled water is filtered through thick filter paper The esters, though now clear, still contain a certain amount of fine emulsion which makes them dark in colour This may be removed by drying on a water bath for two or three hours while stirring constantly with a glass rod The esters are then filtered again and the process is complete

The esters may be washed in the same bottle in which they have been prepared by substituting for the glass stopper a cork perforated with two glass tubes one 2 in in length inserted flush with the inner end of the cork and fitted with a piece of rubber tubing compressed with a spring clamp and the other reaching from the cork to the bottom of the bottle By inverting the bottle the esters rise to the top and the lower layer may be drained off by opening the clamp or without inverting the bottle the lower layer may be siphoned off through the long glass tube

A separating funnel is more convenient for separating and washing esters

2 Hot Process

The esters may be prepared much more rapidly by placing the ingredients in a flask over a water bath arranged to maintain a constant level of water A reflux condenser is fitted into the mouth of the flask The water in the water bath is kept at a temperature sufficient to maintain brisk boiling inside the flask This is continued without stopping for eighteen hours when it will be found that esterification is complete Washing of the esters is then carried out as in the cold process

The weight of the esters recovered is almost equal to that of the oil used

APPENDIX TWO

Data for Intensive Survey

BEFORE beginning a survey all available previous records likely to be useful should be collected and carefully studied

Incidence (prevalence or frequency) should be taken as the number of cases per thousand of the total population It must be specified on what information the incidence is based (1) The information must include the total number of persons residing in the area under consideration (2) the total number of persons examined must be stated and any discrepancy between the total population and the number examined should be explained (3) cases in isolation should be assigned to the area in which they were living up to the time they were isolated (4) all cases of leprosy diagnosed as such by the examiner including quiescent and arrested cases should be recorded

CHOOSING THE AREA

For an intensive survey a limited area must be chosen It should be well defined and if possible form a single administrative unit A preliminary inspection may indicate contrasts between two circumscribed areas which may be elucidated by comparing the results of intensive surveys in each

GENERAL INFORMATION

The following general facts regarding the region and the people should be gathered (*a*) Climate meteorology soil (*b*) geography and topography (*c*) ethnological religious and social grouping (*d*) economic conditions (*e*) diet (*f*) housing and sanitation (*g*) hygiene habits (*h*) clothing

(*i*) prevalent occupations, (*j*) prevalent diseases (skin, epidemic, etc), (*k*) birth rate death rate, infant mortality rate, (*l*) density of population (overcrowding migration, etc), (*m*) history of leprosy in the community (*n*) native folklore

INFORMATION REGARDING ALL INDIVIDUALS

The following facts are required (*a*) serial number of individual, (*b*) house number, (*c*) name, (*d*) age, (*e*) sex, (*f*) race, caste religion (*g*) relationship to head of the family (*h*) physical examination—malnutrition, skin diseases, *other diseases including leprosy (definite or suspected)*, (*i*) history of contact with lepers

INFORMATION REGARDING LEPERS AND SUSPECTS

The following additional information should be collected for lepers and suspected lepers (*a*) Previous illnesses (*b*) History of contact with leprosy—(i) Intrafamilial and/or household contact (bedroom house contact including joint family system) stating family relationship, (ii) extrafamilial (intimate or casual) (iii) contact not known (*c*) Contact period—(i) Time since first known contact (ii) time since last known contact (iii) duration of contact (iv) contact continuous or intermittent (*d*) Particulars about presumed source of infection (*e*) Age at onset of first manifestation of leprosy (*f*) Course of the disease (*g*) Present status description and site of the disease including site of initial lesion (*h*) Laboratory findings examination of smears if possible sections lepromin test (*i*) Conclusions—(i) Leprosy definite type sub type, (ii) leprosy suspected

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